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ABSTRACT

The 22 papers in this proceedings were presented at the 1990 Association for Media and Technology in Education in Canada (AMTEC) conference: (1-3) "Selected Quotations" (R. Heinich, D. Beckwith, P. D. Mitchell); (4) "Responses to P. David Mitchell"; (5) "Build It and They Will Come--Creating the 3rd Wave: The Field of Dreams" (D. Beckwith); (6) "Will There Be a 3rd Educational Technology?" (P. D. Mitchell); (7) "The Future of Educational Technology Has Arrived" (D. Kelly); (8) "The Death (??) of Educational Technology" (J. Godfreyson); (9) "Out of the Mouths of Babes: An Exploration of M.A. Students' Conception of Educational Technology" (R. M. Bernard, K. Lundgren-Cayrol); (10) "Distance Education in Saskatchewan: SCN Style--Equal Access Model" (F. B. Brown); (11) "Two Research Paradigms for Use with Videodisc-Based Stimulus Material in Research on Interactivity and Media Effectiveness" (C. R. Dills, B. Grabowski); (12) "Software Programs That Promote Multimedia Approaches in the Classroom" (B. Elliott); (13) "Video--A Resource for the 90s: Suggestions for Delivery and Integration" (J. Godfreyson); (14) "Postmodern Educational Technology" (D. Hlynka); (15) "The Dynamics of Collaboration" (W. LaDouceur, H. Geissinger); (16) "The Limitations of the Structured Interview as a Data-gathering Technique with Non-elite Subjects" (M. Kennedy, G. Gallant); (17) "Interactive Instruction: An Exploration of Some Crucial Attributes" (J. LaFollette); (18) "Creative Participation in Education and Development--The Wave To Catch" (P. MacLeod, A. MacLeod); (19) "Adaptation and Collaboration: A New Future for Educational Technology" (D. A. Mappin, S. I. Jamieson); (20) "Computer Based Learning Materials as a Means to Improving Student Achievement through Distance Learning" (G. A. B. Moore, K. Sophasan); (21) "Microcomputers in Saskatchewan Schools: 1984-1994" (L. F. Proctor); and (22) "Analytical Tools and Research Issues for Interactive Media" (R. A. Schwier, E. R. Misanchuk). (SD)

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Catch The Wave

The Future Is Now

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St. John's, Newfoundland

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CATCH THE WAVE:

THE FUTURE IS NOW

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SECTION I: INTRODUCTION

The field of educational technology, from its humble audiovisual beginnings over fifty years ago, has become many things to many people. Because it is easier to think in the concrete rather than in the abstract, educational technology is most often thought of in terms of what educational technologists do - they are instructional designers; they manage media centres; they produce mediated instruction; they teach media and technology competencies to others; they work with a lot of sophisticated equipment, and the like. It is because of this inclination to define the field by the way it is practiced that educational technologists seem to share so little in common: the practitioners in the resource centres, the makers of educational television programs, and the university teachers and researchers seem to have little to talk to one another about.

At the beginning of this last decade of the twentieth century, it is our hope that we as members of this profession of educational technology can see beyond what we do, can look at educational technology as a discipline, and can take the beginning steps of relating the discipline to our daily working lives.

Donald Beckwith, Robert Heinich, and David Mitchell are three educational technologists who have moved beyond defining the field by what they do. The following selection of quotations from their past publications will, we hope, help you to move beyond.

SELECTED QUOTATIONS: ROBERT HEINICH

We are at the stage in the development of instructional technology as a field where we must step back and make the institutions themselves the subject of investigation.

Instructional technology becomes an alternative to traditional instruction when it has the capability to take over the initiative for, and the main burden of, the instructional task ... Teachers intuitively recognize the distinction by reducing all instructional technology to complements of their own instruction ...

Our organizational structures are built around a craft model, a model that gives considerable power and discretion to each individual in the classroom ... This is why, as mentioned before, the teacher always tends to reduce technology to tools to be used at his or her own discretion.

... the fundamental premise - the base - of education is that responsibility and authority for instruction are vested in the person who is in face-to-face contact with students in the classroom. A superstructure has developed over the years to maintain and support this fundamental premise.

By using analytical techniques from other disciplines and by treating the institutions themselves as variables, we can come to a better understanding of why some technologies are accepted and others are not. Because the stock-in-trade of educators is knowledge, we instructional technologists operate on the belief that knowledge in itself will change their behaviour. We must realize that educators, the same as other professionals and tradesmen, respond to the organizational structures of which they are a part. To change their behaviours in regard to technology, the organizational structures may have to change. *How* is what we need to determine.

... the basic premise of instructional technology is that all instructional contingencies can be managed through space and time ... primary emphasis is given to the development of more powerful technologies of instruction along with the development of organizational structures that facilitate their use ... As a strategy, as an approach to solving problems, this basic premise of instructional technology

expands theory, research, and development ...

We tend to seek solutions to education problems through technology, to Education through teaching personnel. The two are often in direct conflict ... We do not need more teachers in order to improve science and math instruction.

As technology becomes more comprehensive, more sophisticated, more pervasive, its consideration and use move to higher and higher levels of decision-making; selecting instructional materials to supplement a lesson affects only one instructor; using telecommunications and information technology to create an autonomous institution involves the legislature and a governing board.

A funny thing happened on our way to the systems approach and instructional development. We stumbled over the rigidity of educational governance and the craft structure of educational institutions.

The reorientation of instructional technology from its craft origins to its technology present and future is critical to the continued well-being of the field. Depending on a craft orientation makes instructional technology dispensable - like items of luxury in a period of retrenchment. Technology builds systems that collapse if the technological support - men, machines, methods - is removed (e.g., the importance of the telephone to the conduct of business or the importance of the school bus to the consolidation of schools). Except in rare instances such as the British Open University, we are not even close to that kind of dependency.

One of the aspects of technology least understood by the education professions is the way in which technology changes institutions and professional relationships.

A technology is not accepted or rejected on the basis of comparative performance in its beginning stages. If this were so, railroads would not have been built because the early locomotive lost a race to a horse, and the automobile would never have survived the derisive taunt "Get a horse!"

Hoban (1965) once commented that "the central problem of education is not learning but the management of learning" (p. 124) ... Instruction is the management of learning, and instructional

management, like engineering, is a class of its own made up of a complex organization of men, machines, and processes.

HOBAN, C. F. *From theory to policy decisions. AV Communication Review. 1965, 13, 121 - 139.*
HEINICH, R. *The Proper Study of Educational Technology. In ECTJ, Vol. 32, No. 2, pp. 67 - 87.*
HEINICH, R. *Instructional Technology and the Structure of Education. ECTJ, Vol. 33, No. 1. pp. 9-15.*

SELECTED QUOTATIONS: DON BECKWITH

Change is our game, but we act as if we are part of the establishment. The waves from a rocking boat caught in the undertow pass without notice.

Within educational technology resides the potential for better schooling, better learning, better transmission of information, better interactive communication, better worlds.

Educational technology is visionary, for its base, its vantage point, its lofty goals are all grounded in the future. Its dream is the transformation of the way things are to the way things could be... But the dream, while ever present, remains only a dream. The power, promise and potential of educational technology have not been realized.

... educational technology has not yet assumed its predicted third stage of evolution. Analyses of the past and future essences of educational technology...have determined three levels of evolution. The past has been described as the tools approach (Educational Technology I), i.e., the application of audio-visual devices to the improvement of teaching. The present has been described as the systematic approach (Educational Technology II), i.e., the development and application of methodical, rule-based processes to the facilitation of learning. The future has been described as the systemic approach (Educational Technology III), i.e., the creation of unified and dynamic wholes (from previously separated components) to effect the transformation of learning. The field dreams of the ideal Educational Technology III while operating within the status quo confines of Educational Technology II.

Resultingly, the discontent within the field is mounting. Centering on the inability of educational technology to transform itself from the systematic approach to the systemic approach, this pervasive discontent warns of three debilitating traps - Compromised Integrity, Status Quo Adherence, and Solidification.

The trap of **Compromised Integrity** can be found in three forms: a) Innovation affiliation, b) Greener pastures, and c) Political expediency.

Innovation affiliation. While it is important for a cutting-edge field to be aware of and purposefully incorporate what is new and viable within its systemic framework, educational technology cannot afford to run the risk of defining itself (or letting itself be defined) through current phenomena... Through innovation affiliation temporary survival may be guaranteed at the cost of identity, purpose and cutting-edge leadership.

Greener pastures. The obvious risk in falling into this trap is that of losing one's intellectual integrity by selling out to the highest bidder.

Political expediency. Compromise for political expediency is not a critical attribute of a cutting-edge field. Every instance of relinquishing the integrity of the cutting-edge ideal is one step closer to the status quo.

The trap of **Status Quo Adherence...** awaits in three guises: a) Emulation; b) Legitimacy; and c) Absorption.

Emulation. While dedicated to a transformation to the teaching-learning ideal, educational technology persists in seeking out other models to emulate, status quo fields to mimic, instead of forcing to realization Educational Technology III... If others must be emulated, let it be those who have successfully applied systemic creation to the continual transformation of outcomes.

Legitimacy. What makes for legitimacy in fields that focus their energies on the systematic discovery of what is cannot be the same as that which makes for legitimacy in a field that focuses its energies on the systemic creation of what could be.... Our potential legitimacy lies in the systemic approach of Educational Technology III...Until this has been accomplished, yet another trap looms - that of being absorbed by status quo legitimates.

Absorption. Educational technology has done very well with respect to surviving. But this survival has been at the cost of attachment to and absorption by other fields...While the cutting edge is sharp and at times scary, the risk is far greater if someone else is allowed to hold the handle. While there may be untapped fields willing to absorb educational technology into an adjunct role, the ultimate

consequence of the trap of absorption is the loss of the singular identity necessary to realize our unique potential to lead in the creation of ideals rather than to serve for the betterment of the status quo.

The trap of **Solidification**...Reducing findings to a rule can be said to be characteristic of the systematic approach of Educational Technology II. Through continued reduction to uniformly applied rules, educational technology can solidify at the status quo, relinquishing the systemic dynamism necessary for transformation to the ideal...Systemic ends cannot be attained via systematic means.

Two things must be done in order to resolve the current educational technology dilemma: a) reaffirm and publicly proclaim the goal and philosophy of educational technology, and b) create systemic roles for educational technology, educational technologists, and research in educational technology.

The systemic approach enables us to serve as the problem-solvers of the learning process, the dreamers and creators of new and more effective learner systems.

If Educational Technology III is to emerge and work, every educational technologist must be capable of systemic operation...The ideal educational technologist is not one who follows all of the known rules, not even one who follows all of the known rules well. The ideal technologist is one who breaks the known rules and creates new rules, thus enabling accomplishment of systemic creation, the type of creation not possible through the application of known, status quo, systematic rules.

The role of the educational technologist is one of catalyst of optimism, aligned, at least in spirit, with others who are proactively trying to raise the roofbeams, to elevate the actualized potential of human performance.

To fulfil its dream, educational technology must reclaim its rightful place on the cutting edge - constantly pushing upward to the next level of transformation, applying constructionism to what needs to be. While life on the cutting edge is, at best, uncomfortable, this is where the systemic, transformational field of educational technology must reside to realize its destiny.

BECKWITH, D. *The future of educational technology. IN CJEC, VOL. 17, NO. 1, PP. 3 - 20.*

SELECTED QUOTATIONS: P. DAVID MITCHELL

And what about educational technology? There is a dangerous precedent for defining it as what practitioners do: function becomes purpose.

Educational technology must be dedicated to the efficiency of education as a whole and not simply to specific operations.

In his paper portraying "The Future of Educational Technology," Beckwith argues that, "If we are to survive, purposefully, as the cutting-edge field of our original vision, there are some solution-related traps that must be avoided" (Beckwith, 1988, p. 8)....These are not traps to be avoided: they are symptoms of incurable terminal illness.

Most definitions of educational technology assert that it is concerned with applying knowledge, systems and techniques to improve the process of human learning. But virtually all educational technology research and applications have attempted instead to improve instruction, especially through information display systems and clarification of objectives as observables.

If educational technology is to contribute to the solution of educational problems, we must first come to grips with the scope and purpose of education. Educational technology then may be in a position to identify worthwhile solutions.

The essence of technology, and therefore educational technology, is knowledge about relationships.

In the context of educational technology, we must be able to have a workable model of our students, the organization within which we work (or install our solutions), indeed, of our society within the global community. This is a mind-boggling task and our collective failure to do it is one of the reasons for the fatal illness of educational technology.

Perhaps some of us are predisposed to accepting a cybernetic or systemic world view; others may not be. But if educational technology is to become a viable enterprise, I think we will need a massive shift in this direction.

What are the implications for educational technology if it's to be rejuvenated? If one's perceptual field determines his behaviour, it seems reasonable to conclude that educational technology has two options. We can continue to implement schemes that limit opportunities for individual differences, developing representations of knowledge that omit much of the richness of a subject in their emphasis on achievement of specifiable objectives in a limited time. Or we can recognize individual differences and attempt to promote the optimal development of each person, providing opportunities to extend the self-regulatory capacity of the person both within a subject domain and in general.

One thing is clear to this observer; the corpse called educational technology appears to have died because it lacked a cybernetic systemic paradigm and an organizing principle to give it life as a viable system dedicated to improving education....If we all work together we may just be able to save educational technology and thereby education. But we shall have to struggle with our regulatory systems. This will require allocation of scarce resources to do the job - resources such as care, creativity, commitment and love. Perhaps these are the only assets educational technology has left.

We may be able to revive the corpse of educational technology but not without a radical transformation in a number of inter-related domains; our professional associations; our graduate programmes preparing future practitioners; our schools, colleges, universities and ministries of education; our media of mass communication; our governments; our corporations; our society and - most important - ourselves.

The last reported resurrection required only three days. How long will it take to resuscitate and transform educational technology?

MITCHELL, P. *The future of educational technology is past. IN CJEC, VOL. 18, NO 1, PP. 3-27.*

RESPONSES TO P. DAVID MITCHELL

Agostino, A. (1989). Mitchell's wake. Canadian Journal of Educational Communication, 18(2), 125-126.

"His [Mitchell's] refurbished viewpoint is further heightened when he conceives of educational technology as a metasystem which (although not viable in itself) comprises many viable systems, namely its proponents and practitioners who can offer it consistency." (p. 126)

"In the end, Mitchell's article is more of an impatient call for coherence (and rightly so) in the field, rather than a post mortem analysis." (p. 126)

Winn, W.D. (1989). Revitalizing educational technology: A response to Mitchell. Canadian Journal Of Educational Communication, 18(2), 149-152.

"The majority of people in our field have completely misunderstood system theory, interpreting a powerful conceptual tool as a series of mechanistic techniques. Our graduate programs have failed to provide students entering the field with anything like a conceptual basis for what they are being taught to do (Stewart, 1985). And our professional associations have failed miserably in the exercise of leadership in identifying and developing the theoretical framework, or organizing principle, the field so badly needs." (p. 149)

"One healthy sign for our field is that just about everyone working in it has their opinion about what should be done. People are thinking and talking.....This kind of dialogue indicates to me that the field is neither dead nor moribund. Being an optimist, I suspect that what Mitchell has seen as death is in fact a mid-life crises. Such crises are certainly not fatal; they are simply part of growing up." (p. 151)

Torkelson, G.M. (1989). The future of educational technology is past - A reaction. Canadian Journal Of Educational Communication, 18(2), 146-148.

"I agree with Mitchell's analysis. It addresses a fundamental problem of most educational technologists who tend to focus upon the sophisticated dissection and creation of instructional processes and instrumentations, more than upon the actual accomplishments of learners in achieving personal/societal goals and in acquiring enduring skills and knowledge." (p. 146)

"And another problem is that sometimes there is a tendency to judge technologists' competence more on the basis of models and complicated instructional systems than on the effects of those systems in producing learner satisfactions and intellectual,social emotional growth." (p.146)

"By building on what has already been accomplished in specifying educational goals and learner behaviours, it may be possible to avoid the conclusion that "the future of educational technology is already past" by focusing on those areas where societal systems and subsystems must collaborate with instructional designers in creating the utopian interactive, self adjusting system. To do less, even in a small way, is apt to result in Mitchell's prediction of the demise of educational technology, as we now know and practice it." (p. 147)

Duchastel, P. (1989). The upcoming of learning technology. Canadian Journal Of Educational Communication, 18(2), 137-139.

"He [Mitchell] forgets, however, how valuable even routine ET can be in instructional design (when not involved in foot-shooting, of course). My own personal experience in large-scale training programmes has pointed that out to me whenever I have contrasted the quality of training materials developed through an ISD process with the quality of materials developed without such a process. Even if it is limiting, the instructional systems design process can be

beneficially applied to many educational and training problems." (p. 138)

Kerr, S.T. (1989). There are no ends, only means. Canadian Journal of Educational Communications, 18(2), 143-145.

"Unfortunately, we have kept our faith in systems theory while others all around us have been losing theirs." (p. 143)

"The problem of trying to apply systems theory to research and practice in education is that, unlike physical systems where laws may be assumed to underlie observed events, the variables affecting instruction are presently less amenable to a simple physical description. Conceptions of learning, definitions of curricular content and structure, models of instructional methods, approaches to monitoring and evaluating educational results, ways of delivering and administering educational services - all these are subject to multiple definition based only partly on purely scientific phenomena." (p. 144)

"Technologists, in short, need to become educational practitioners, working in classrooms with teachers, as well as activists versed in the political and social context of the educational system." (p. 145)

Hannafin, M.J. (1989). The death of educational technology has been greatly exaggerated. Canadian Journal Of Educational Communication, 18(2), 140-142.

"Which educational technology has died? We are not a unitary field, but a meta-discipline of sorts. We are found across academic disciplines, in public and private educational settings, in R&D institutes, and across ages, grades and levels from preschool through adult. All subsets cannot be tarred with the same brush." (p. 140)

"Educational technologies offer both potentials and perils, but they are not, and never have been, panaceas to all that ails either education or society. We welcome all that educational technology can provide to address societal ills, but we cannot reasonably assess the potential or performance of educational technology by its lack of impact on problems for which it was neither intended nor implemented." (p. 140)

"The inherent diversity in training, emphases, and program views will continue to hamper the development of educational technology as a discipline, but the liabilities of adherence to a unitary view of the field more than outweigh the potential advantages." (p. 141)

Davies, I.K. (1989). Total educational technology (TET): Challenging current limits. Canadian Journal Of Educational Communication, 18(2), 132-136.

"Educational technology does not have the richness of meaning that it ought to have. It has acquired mechanistic, systematic, engineering nuances, that seem to deny our wider educational responsibility. There is an unfortunate void between our words and deeds, ideas and practice." (p. 133)

"Educational technologists have a bias for action, and this bias has, at times, caused us to lose track of our vision." (p. 133)

"Perhaps the view of instructional development, with its concern for often only instructional materials, has become an albatross around our necks. The perspective is too narrow. It limits the scope that on the one hand demands a world view, and on the other a concern with the whole range of human potential and performance - including not only fitting people to a task and environment, but also fitting the task and environment to people." (p. 133)

"Educational technologists in the past have often unwittingly optimized sub-systems and components, and so created a cancer that ultimately threatens the "health" of the total system.

This is one reason that educational technology projects have sometimes failed to realize their potential. Problems were conceived too narrowly, and designs developed in isolation from their environment. It is an example of what Adler calls the fallacy of reductionism - "assigning a greater reality to the parts of an organized whole than to the whole itself" (Adler,1986,p. xix)" (p. 134)

Beckwith, D. (1989). Fashioning the future educational technology: An invitation. Canadian Journal Of Educational Communications, 18(2), 127-131.

"Today's futurist educational technologist envision yet another means - a systemic approach to developing learning environments and studying the learning process, ultimately effecting a means-end entwining wherein the learner is the educational technologist." (p.128)

"Two aspects of the theory of educational technology give it strength, and our ability to embrace the future as we create it: a) our theory is primarily a set of proactive principles, a belief system to be affected; and b) our theory has the potential to empower any component of the educational technology system." (p. 128)

BUILD IT AND THEY WILL COME: CREATING THE WAVE: THE FIELD OF DREAMS

Don Beckwith

FOREWORD

It has been a while since my two articles on the future of educational technology appeared in the *Canadian Journal of Educational Communication*. Both articles were filled with ideas and viewpoints. But, like the weather, ideas and viewpoints can change dramatically. Some are strengthened by additional experiential evidence. Others are challenged out of existence. By the time an idea has appeared in print, my view has already been, and continues to be, modified. Accordingly, this short paper has the purpose of serving as a transition from the ideas and viewpoints presented in the two articles to the ideas and viewpoints that will be presented during the AMTEC '90 Keynote Session: "Educational Technology: The Dialogue of the Decade".

INTRODUCTION AND BACKGROUND

Introduction

Where has educational technology gone? Not the educational technology that can be defined by current practice. Not the educational technology that designs instructional systems to corporate specifications. Not the educational technology that is used and abused as an ad-on afterthought to the real meat of the curriculum itself. Not the educational technology that is wrestling for survival. I'm wondering where the real educational technology has gone -- the educational technology that was already in our hearts when we happened upon our field.

It was a field that seemed to be offering a way to the actualization of that which we had always known, not by instinct, while seemingly so, but by the lifelong testing of our overriding belief (Dare I call it philosophy?) that all humans are capable of achieving their very high potential for learning. It was a

field that could be used as a tool to prove to the world the validity of our philosophy. It was a field that openly professed a philosophy that we, as individuals, were careful to keep hidden lest we be labelled fanatics of some sort. It was a field that suggested that learning environments could be systemically fashioned in such a way as to guarantee learning success.

It was a field that considered the learner's motivation as well as the levels of learning inherent within the skills to be learned; the needs of society as well as the instructional resources at hand; formative as well as summative evaluation; learners' styles and pacing of learning as well as mandated curricular sequences. In short, it was a field that saw any teaching-learning environment as a potential system that could be structured to facilitate the learning of all learners. It was a field that was readily embraced by altruistic educators with a dream of excellence for society, excellence for the profession of education, excellence for the individual learner. Where has educational technology gone?

Background

I was drawn to the general field of education because of its positive goals for individual learner excellence. While to me these goals talked of the future, realizable potential of each and every learner, I found out soon enough that the educational establishment was primarily in the business of maintaining the status quo; only a very few learners were expected to excel in anything, and often there were aspects of the educational environment that were designed to facilitate the realization of this expectation, by spreading students out based on their "natural" abilities.

I don't know about you, but it certainly didn't take me very long to start looking around to find out if the field of education had any magic left in it. During my search for magic, I found the field of dreams -- educational technology. At about the same time, the general field of education also found educational technology -- knocking on its door. Where has educational technology gone? To the wrong clients.

Educational technology was seen as a threat by the established educational system, and rightly

so. Let's face it. Here was a group of educators spouting quite radical ideas -- that all students could succeed, that educational institutions could assume responsibility for the learning that does or does not take place within the educational system. Further, and far more scary to the establishment, here was a field that might get rid of all semblance of comparative scoring and grading; that might individualize learning; that might substitute teachers, where appropriate with media; that might contract other agencies to perform certain teaching obligations. Here was a field that could replace every element of the educational establishment with a new educational ***system***. Here was a system of dreams that was capable of simultaneously attending to appropriate goals; objectives; formative and summative evaluation; teaching methods; delivery systems; media selection, utilization and production; learning styles; learning theory; instructional theory; systems management; societal needs; instructional design; message design; etc. -- a system that could work, a system that could produce learning results, a system that could replace the educational establishment.

It is not hard to imagine what happened next. Lip service, of course, was given. (Who can speak out openly against the educational dream of worthwhile learning for all?) After a few superficial inroads were allowed, educational technology was very carefully redefined by the educational establishment. While educational technology alone has the capability of systemic curricular definition, design, development and evaluation, we have rarely, if ever, been allowed to exercise this capability. All too often, the needs, goals, desired levels of performance, the curriculum and the content to be learned have been determined by others. All too often, the maximum allowable time for instruction, the audience, the size of the audience, and the learning environment have been determined. By and large, it is within such a predetermined framework that the current practice of educational technology has been allowed to operate. While educational technology is capable of imaging and bringing to realization the whole potential picture of learner excellence, it has been allowed to select the color for the matting and the style of the frame. This scenario has been replayed in every educational and training arena that educational technology has sought to play in. Where has educational technology gone? To the wrong

clients; to clients who feel threatened by the potential of the field of dreams.

A TRANSITIONAL PROPOSAL

As I see it, two things must be done if we are to regain our field of dreams. If the future educational technology is to recapture and realize its original intent, we must: (a) cease defining our field by current practice, and (b) select the right clients. If we do this, each and every aspect of educational technology, e.g., media management, instructional design, evaluation, front-end analysis, media production, research, etc., will have to be reconceptualized accordingly.

Defining Educational Technology

Educational technology, as a field of constant change of focus and emphasis, cannot be defined by current practice. That is, we cannot look around to see what it is that educational technologists are now doing and try to define our field accordingly. As a field of dreams, the definition of educational technology can only come from the dream itself, from the goal of the field, from the ideal that our field is striving for. If our definition concentrates on the status quo of current practice, we run two major risks: (1) that the definition will have to be changed to match every new means that is used by educational technologists; and (b) that the means that we are so busy describing and analyzing in order to define our field may be completely inappropriate for the goal of educational technology that we are too often so careful not to define.

What is the dream? What is the goal of educational technology? The phrase that really catches my imagination is "to improve learning". From my perspective, as dreams go, you can't get much better than that: To improve learning. Wow! Who could argue with that? To improve learning. It seems to have everything going for it. By using the infinitive (to improve), it's future oriented. The word "learning" puts us right where we feel comfortable; it puts the emphasis on the learner, but at the same time does not exclude the teacher or the learning environment. By using the word "improve", we suggest that we are

in the business of proactive, positive change. Yes, "to improve learning" has a lot going for it.

What it doesn't have going for it is specificity. It's too easy. We can all just nod and say to ourselves (or aloud), "That's good; that says it all; that's what we stand for -- "to improve learning" -- Amen! Without the specificity, we can easily justify anything we do as fitting nicely within the dream of "to improve learning". As long as we are trying to improve learning (whatever that means) -- to whatever extent -- we are practising educational technology; we are practising educational technologists. Without the specificity, we don't know whether we are in the business of improving individuals' processes of learning or the learning of specific skills or information or both. We also don't know whether we are trying to improve what others have specified as worthwhile (in which case we become "mere vehicles" to someone else's goal) or are trying to improve what we have specified as worthwhile.

Let's work on the specificity. First, if we are really committed to improving learning, let's decide exactly what that means. Next, let's decide whose learning we want to improve and to what extent. If we are interested in the improvement of specific skills and/or information, let's agree as to what these are. If, on the other hand, we are interested in improving all learners' learning processes, we must decide what processes need improving and to what extent. Also we need to decide where we will start, with whom (what population) and when, if ever, we will be finished. For example, we can, as the field of educational technology, decide that we want to improve each and every individual's process of learning so that each would be capable of high-level problem-solving, and then go about doing just that.

Selecting the Right Clients

When a field has a powerful process that can be used to effect positive change, it must take the responsibility to determine who its clients and recipients may or must be. Educational technology can continue to do business with the middle people, e.g., the teachers, administrators, corporate heads, trainers, training departments, etc. Within this context, we might, as a profession, choose to serve the perceived needs of those who interact with or have ultimate responsibility for the learners. We might

choose to conduct a needs assessment from the vantage point of these perceptions. We might choose to create instructional systems designed to facilitate the learning of information and skills prescribed by these perceptions. We might choose to assess learning within the parameters of these perceptions. We might choose to evaluate and improve the instructional system using criteria derived from these perceptions.

Or educational technology can proactively begin to do business directly with the consumer, the individual learner. Educational technology might choose to serve the learning needs of each and every individual learner, believing that this focus will effect a far greater payoff to society.

If educational technology decides to define itself according to its dream rather than by current practice, and if the individual learner becomes our primary client, the ramifications for our field will be many. My perspectives on the preferred definition and clientele of the future educational technology and the resulting, necessary reconceptualizations of each aspect of the future educational technology will be discussed during the Keynote dialogue.

WILL THERE BE A THIRD EDUCATIONAL TECHNOLOGY?:
Notes for a Paper to Start a Dialogue

P. David Mitchell

Here I sit, in my ivory tower, attempting to formulate my thoughts while contemplating a flight to Avalon where I am supposed to help create the third wave in Educational Technology. Because this may be related to its antecedents, I struggle with the logical question, "What were the first two waves?"

Many candidates come to mind for Educational Technology 1 and 2: AV media and programmed instruction/instructional design; school-based methods/media and military-industrial methods/media; instruction-centred methods and learner-centred methods; mass communications and self-instruction; information storage/display systems and intelligent systems. Whichever we select, it strikes me that two fundamental issues are common to each. First, most of the R & D money came from the military and therefore we must carefully consider whether, and to what extent, they are valuable for educational technology. Second, implicit in all of these approaches is that the learner's needs take second place to those of the system within which learners are found.

Creating a Profession

Is educational technology to be a general field, perhaps like the health sciences, with many specialities? Or is it a non-field in which anyone, with a modicum of common sense and creativity (plus some basic concepts and procedures), can toil--provided someone will employ them? Most of us wouldn't dream of calling ourselves a chemist or engineer, not to mention a dentist or mathematician, after reading a few books, attending a few three-day workshops or taking a three month course. Yet "Educational Technology" is full of such people. Where else would you find high school dropouts and graduates, university dropouts and graduates, as well as people with a Ph.D. (in almost any subject) doing essentially the same work and considered to be in the same profession?

What do chemistry, engineering, medicine, etc., have in common? Each seems to have a body

of knowledge, theoretical models and problems to solve. Educational technology may not have advanced far enough for us to have produced much knowledge or any theoretical models of our own, but surely we can find problems worth tackling. If we can solve them, then we may be able to contribute to the emergence of conceptual models. What kinds of problems need to be addressed?

Systems With Systems Within Systems

An educational problem may be far greater than the restricted vision of many observers would suggest. To illustrate, an instructional design problem may be considered as such (with implications for graphics artists, media producers, etc.) but the instructional activity itself is embedded in an organization (school, corporation) that has other subsystems with different, often competing, goals, priorities, etc. And this organization is embedded with other interacting systems in a larger system. Simultaneously there are teachers, learners, managers and perhaps family or employers or competitors whose behaviour and perceptions are relevant. Beyond this are social needs and ethical issues. In short, almost any educational technology activity is much more complex that it seems at first glance. Let's start with a wide angle lens.

Systemic Thinking is Needed

The world is in a critical phase of its evolution. The opportunity for untold wealth is nigh; so is the possibility of disaster. Various authorities suggest that continuous education soon will be a form of universal occupation. Yet most people in the world live in the stick age; they get their energy from burning sticks and their life style centres on hand hoe agriculture. They strive for self-sufficiency constrained by their environment. We, however, are confronted with what some fear could herald a return to that lifestyle (insofar as massive unemployment produced by robots and other expert systems might reduce our economy to a shambles). In the USA (and perhaps in Canada?) we see shocking reports of the failure of the school system to turn out literate graduates; adult literacy is falling; etc.

What problems are we capable of tackling? Can we do anything?

Our leaders in government, industry and education face many complex, inter-locking problems and possibilities. We are immersed in an era of unprecedented changes in what is possible as a result of our decisions. Perhaps most significant is the increasing rate of change. We have just become accustomed to the silicon chip and now must adapt to a protein chip that promises to increase the density of a chip by 160,000 times. Similar developments are occurring in data storage systems. Can we even conceive of the potential impact of such developments on education and training? Let us try.

Our Task: Create Educational Technology

One of our tasks then is to consider not what the Third Educational Technology will be but what we want it to be. For it is up to us. As Margaret Mead pointed out, "Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it is the only thing that ever has."

THE FUTURE OF EDUCATIONAL TECHNOLOGY HAS ARRIVED

Don Kelly

In my current post as manager of interactive distance education at TV Ontario, I have had the opportunity to travel extensively to see what others are doing in the field. My travels have been primarily in the United States, where it is obvious that a revolution is going on in the use of technology in education - particularly television in association with several other technologies. I believe that the Third Wave has arrived, with the television medium acting as the catalyst for change.

Television has been criticized for many years as a passive medium; the latest attack includes a charge that TV viewing leads to weight gain. Of course, there is some truth in this criticism, if you consider the term "couchpotatoes". However, educational TV projects have never been designed to be passive, one-way presentations.

For the most part, they have been designed as catalysts for interactivity in a classroom - and most of our teachers, elementary through postsecondary, do use television programs this way. But it is rare for TV programs to be used with other technologies.

Enter teleconferencing and direct teaching using TV, telephones, computers, fax machines, etc.- which have changed the picture dramatically.

In secondary schools all over the United States, students are being instructed by teachers at remote sites who interact with their charges via video, telephone, and computer.

Propelled by funds from a federally funded project titled Star Schools, state education officials in over forty states have installed (or are about to install) satellite dishes on most or all secondary schools in their respective states. Students receive two or three "broadcasts" per week from the teacher and interact, using a telephone and a specially designed computer. Fax machines are used to dispatch documents, assignments, etc., from the instructional centres and vice versa.

This model has been developed by educators across the U.S. and is based on highly successful

interactive television instruction used in business for employee training. Its success is illustrated by the very high degree of cooperation developed between state educational agencies and school boards, and the cutting across school boundaries. There is also an apparent increase in student achievement in certain courses. At the very least, there are thousands of students taking courses that otherwise would not be available.

A similar development at the post-secondary level has been the rapid development of teleconferencing as an educational outreach model. Again, using television, satellite uplink and down-link technology, the telephone, and other equipment, teleconferencing has rapidly become a popular form of learning. I am sure you are aware that there are several teleconferences available each week (perhaps each day) to willing participants.

If we seriously believe that the third educational technology is "a holistic/systemic approach characterized by integration, interactivity, and collaboration, with an emphasis on management and process", then we must look closely at the models I have described above. At TV Ontario, we are doing precisely that. In the late fall of this year, we will launch some experiments,using a revitalized daytime schedule, targeted at specific client groups. We intend to introduce a degree of interactivity, using other technologies with one-way TV broadcast. We also have ambitions to start a third network, which would be devoted to professional development, training, and the like, and which would have a large degree of interactivity through the use of telephones, computer, and fax. You should note, however, that television will remain the focus for our activity.

We all know of technology marriages in other fields. Some of these marriages are highly successful in their own right - witness the marriage of video and computer as an interactive videodisc.

I think we are on the verge of seeing the manifestation of Don Beckwith's principles for the future of educational technology, particularly that "environments can be structured, in a systematic fashion, to effect successful learning and motivation". I, for one, believe that the future of educational technology has arrived!

THE DEATH (??) OF EDUCATIONAL TECHNOLOGY

John Godfreyson

The prospect of being a member of this panel caused me considerable concern since it required that I take the time to clarify my own thoughts about the topic of educational technology.

After reading a number of articles written by those present as well as others I found myself attempting to fully realize the meaning of the death of Educational Technology in terms of writing an obituary which is meant to either mourn or celebrate the passing. I would like to read that to you.

Technology, Educational - Obituary

> Passed away sometime during the last few years. Last place of resident appears to have been throughout the educational system in various forms. Active in a number of professional organizations and played a leadership role in trying new innovative approaches to teaching and learning.
>
> Best known for forays into the use of three main approaches: the tools approach (made evident through the use of a variety of equipment), the systematic approach (best described through an analytical approach to the use of instructional design theory) and the systemic approach (a more recent attempt to consider a holistic cybernetic approach to developing learning environments).
>
> Suffered considerably from the ravages of compromised integrity including innovation affiliation, political expediency and greener pastures. Continually frustrated by the need to maintain the status quo as dictated by organizational and bureaucratic needs.
>
> Greatest wish was to create systems to affect learner performance at the highest levels in both the affective and cognitive domains. Survived by various individuals who are constantly striving to redefine the role of educational technology in terms of a changing society.
> In lieu of flowers, donations can be made to the Fund for Enabling Learners.

My apologies to members of the audience who find this to be a rather morbid approach to the subject. However, there is an Easter message. Out of the struggle for anything worthwhile there is usually the promise of better things to come.

The balance of this presentation will deal with my perceptions of the transformation of education in British Columbia and the role of educational technology in accomplishing those objectives.

The Sullivan Royal Commission on Education was released in August, 1988. My recommendations for change were indicated. In January, 1989 the government released a paper on the Mandate and Policy Directions for Education. Since then the Ministry of Education, in consultation with many groups, has proposed a restructuring of the school system for the Year 2000. The thrust of this restructuring revolves around the theme of enabling learners.

Three guiding principles or assumptions are made regarding learning and the learner:

1. Learning requires the active participation of the learner.
2. People learn in a variety of ways and at different rates.
3. Learning is both an individual and a social process.

These principles along with the appropriate restructuring of the educational enterprise promise to afford many opportunities for the birth of a new improved educational technology.

With caution, I suggest that Educational technology will become a multi-disciplinary environment concerned with the development of 'learning systems' which will provide access to support for the learner. This support will allow the learner access to teachers, tools and resources, the goal of which will be to reduce the time spent in accessing this support and increase the time in processing information. Because of the relative ease of access, the learner will have a greater opportunity to define needs and explore solutions. Learning might be defined as the process of solving real world problems in a social context. Learners will move from experience to knowledge and from the concrete to the abstract. Education will be involved in the pursuit of significance and society will benefit from the ability to realize the greater potential of the learner.

In order to accomplish these "lofty" purposes it will be necessary to define and create these new educational technology systems. This will require the interplay of those who understand the tools, those who have experience in the design of specific learning experiences and those who have the understanding to bring all these elements together in a context which affords both the designer and the

learner an opportunity to restructure the relationships of the component parts.

This might be referred to, for want of a better term, as the Legoland approach to Educational Technology. The learner is provided with a number of seemingly unrelated pieces. Learning is required in order to determine the ways in which the parts are assembled. In addition, for the learner, there must be the motivation to create a meaningful result. The assemblies constructed by a variety of learners may all be different but similar knowledge and skills have been developed by all participants.

If as educational technologists we can assemble similar higher level learning environments, there is the promise of developing the learning environments which will enable the learner to explore and construct appropriate experiences which in turn develop the knowledge and skills which are perceived as necessary to enable learners to view and use learning as a life-long tool.

No, educational technology is not dead, it is undergoing metamorphosis and will burst forth again in a new form, only to repeat that cycle again at another time.

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SECTION II: INTRODUCTION

Published articles and papers on educational technology number in the thousands. But many conferences year in and year out feature excellent presentations which, once heard, disappear except in the memory of those in attendance. It is our intention to prevent some of the AMTEC'90 presentations from suffering such a fate.

From the many excellent program proposals submitted to AMTEC'90, the Conference Publication Committee solicited a number of papers for inclusion in the conference publication Catch the Wave: The Future is Now. The papers in this section were selected on the basis of their relevance to the theme of AMTEC'90.

OUT OF THE MOUTHS OF BABES: AN EXPLORATION OF M.A. STUDENTS' CONCEPTION OF EDUCATIONAL TECHNOLOGY

Robert M. Bernard
and
Karin Lundgren-Cayrol

INTRODUCTION

In a job interview for a training position, the interviewer ended the session by saying to the applicant, a recent M.A. graduate in educational technology, "Well you seem to have a very good background, but what is this thing called educational technology on your resume?" Another ex-student remarked, "When I was a teacher, my parents were certain I was a contributing member of society. Now that I'm an educational technologist, they're not so sure."

The Professional Model

Coming from people outside of the field, comments like these suggest that educational technology is not a self-explanatory term, and that the mixture of the terms "education" and "technology" is ambiguous. But even within the field, among academics and practitioners alike, there has been considerable controversy over both the conceptual underpinnings and the practical issues of educational technology. Questions like the following have been the focus of concern:

(a) What is the definition and origin of the field? (Lumsdaine, 1964; Seattler, 1968; Engler, 1969; Davies, 1971; Mitchell, 1977; Heinich, 1984; Gentry, 1987; Ely & Plomp, 1988; Eraut, 1989);

(b) What "traps" do its practitioners face? (Bernard, 1986; Beckwith, 1988);

(c) What is the relationship between theory and practice? (Hortin, 1988; Winn, 1989);

(d) Has the field succeeded or failed to achieve its mission? (Mitchell, 1986, 1989); and,

(e) What are the present and future roles of educational technologists? (Mitchell, 1975; Rossett & Gaborsky, 1987; Spitzer, 1987).

Some would argue that we are no closer than we ever have been to answering many of these

fundamental questions (Mitchell, 1989).

One issue that has plagued the field from its early years, is the relationship between what Lumsdaine (1964) and Davies (1971) call the "two educational technologies". So called "hard technologies" encompass the physical devises that are developed or adapted to support teaching and learning. The "soft-technologies", such as cost-effectiveness analysis, systems techniques, instructional design and formative evaluation have emerged through the influence of disciplines like management science, behavioral and cognitive psychology and communication studies and are largely "process-oriented". Each conception of the field has attracted its share of adherents and detractors. On the one hand, an interest in the devices of instruction has sometimes been criticized as, "developing solutions in search of a problem", while the more academic orientation towards "soft technologies" has been characterized as "much ado about little or nothing".

Plomp and Pals (1989) describe three foci to educational technology. ET-1 is similar to the "hard technologies" notion mentioned above. ET-2 refers to processes and techniques for designing materials to support learning and is similar to the "soft technologies" terminology of Lumsdaine and Davies. ET-3 is a general orientation to problem solving involving a holistic or system approach within the context of the problem area. ET-3 is more a philosophical perspective and a way of thinking about problems than a set of techniques or approaches.

The Student Model

Between the completely naive bystander and the knowledgeable professional educational technologist, lies a group of individuals who are becoming initiated to the language, concepts and techniques that make up the field. These are students just entering graduate study. They are not completely naive, since they have committed themselves to entering upon a several-year program of study. But their concept of educational technology and their reasons for studying it cannot be as well formed as students embarking on graduate study in a field like psychology, where an undergraduate

degree is required. What do these students think about the field? Does their concept of educational technology match the commonly accepted descriptions? What is their purpose for entering the field? These questions are the focus of this study. Another question of interest to the present study is whether the concept of educational technology and the reasons for studying it has changed over the course of the 1970s and 1980s. Archival application records from the Graduate Programs in Educational Technology at Concordia University made answering these questions possible.

More specifically, there were two primary research questions:

(a) Are there a set of core concepts and reasons which underlie entering students' perceptions of the field and their place in it?; and,

(b) have these concepts and reasons changed over the 21-year history of the program?

DESCRIPTION OF THE STUDY

Student Participants

Participants in this study were 408 students who were accepted to the M.A. program in educational technology between the years 1968 and 1989. Their demographic characteristics are as follows: (a) Mean age - 31 years, SD = 7.5); (b) Sex - 42% were male and 57% were female; (c) Origin - 57% were from Quebec, 21% were from other parts of North America, 17% were from developing countries and 5% were from Europe; (d) Language - 71% were anglophones, 12% were francophone and 17% were other than these; (e) Educational Background - 88% entered with a B.A., 5% with M.A. and 7% with other qualifications, equally distributed among education, psychology, linguistics and communication (approx. 15% each); and (f) Professional Background - 59% from education, 23% from various aspects of management and 18% from media design/development.

Sources of Data

Demographic data were collected from the regular graduate studies admission form. In addition to this it has been the custom in the program to ask prospective students to write a short essay answering two questions: "What are your reasons for entering the educational technology program?" (henceforth referred to as "Reasons") and "What is your conception of educational technology?" (henceforth referred to as "Concepts"). These essays ranged in length from approximately 100 to 300 words.

Research Approach

Design. The study described here is referred to as *ex post facto*, where variables are, by definition, not manipulable because they have already occurred in time (Kerlinger, 1973). Inferences drawn from studies of this sort are tenuous at best because only correlational relationship may be expressed. Care has been taken in interpretation because of this weakness in the research design.

Coding. Subject responses to the two questions were classified using a keyword technique similar to that used in identifying 'idea units' in verbal learning studies (Kulhavy, Schmid & Walker, 1977). Student files were first randomly ordered. Keywords and phrases were then extracted from the verbal transcripts and coded numerically. Earlier transcripts yielded more keywords than later transcripts. Of the 48 keywords identified for "Reasons" and the 54 keywords found describing "Concepts", more than 50% of the keywords came from the first 50 transcripts. No new keywords were found in the last 50 transcripts. These categories were scrutinized by two 'experts' in the field and were then collapsed into 22 "Reasons" and 32 "Concepts". These collapsed categories became the basis for the statistical analyses.

STATISTICAL APPROACH AND FINDINGS

The statistical analyses were performed in two related steps to answer each of the research

questions.

Question 1: Conceptual Structure. Factor analysis was used in the first step to generate clusters of related "Reasons" and "Concepts". The first part of the procedure, called principal components analysis, locates an initial factor structure (i.e. responses common to a set of problem dimensions) among correlated variables. To improve the strength of association between variables and factors, varimax rotation was applied to the principal components solution.

For "Reasons" data nine factors were found to have an eigenvalue over 1.0 (the criterion often used to judge the strength of association within factor analysis). Together, these factors accounted for 56% of the total variance in response to the "Reason" question. These factors are shown in Table 1 and are labelled according to the highest loading variables in each one.,

"Concept" data were treated in a similar fashion. In all, fourteen factors with eigenvalues over 1.0 were found, accounting for 62% of the total variance. Table 2 shows these factors arranged according to their highest contribution to the factor structure. Factor analysis was run separately for "Reasons" and "Concepts" in an attempt to further reduce the keywords to empirical clusters and to determine if there was a coherent conceptual structure underlying student responses. Factor scores were derived through this process, for each subject, and served as the input to the second step.

Question 2: Changes over time. The second question involved an exploration of changes in "Reasons" and "Concepts" over time, from the inception of the program to the present. In order to simplify the analysis, year of entry was divided into three periods: 1968 to 1974 (n = 82, 20%), 1975 to 1981 (n = 120, 29%) and 1982 to 1989 (n = 206, 51%). Discriminant functions analysis was conducted to determine which of the factors identified earlier best predict (discriminate) the period of student entry.

Discriminant functions analysis is a statistical technique that identifies a set of discriminating variables which best predicts group membership among subjects in the study. In this case, time period served as the group membership definition (with subjects belonging to one of three periods) and the

factor scores derived from the factor analysis served as the predicting variables. Factor scores, which are z-scores in that their distribution has a mean of 0 and a standard deviation of 1.0, served as the data. Table 1 and Table 2 show the means for each factor over the three time periods and the unvariate F (to enter) and multivariate (F to remove) test of discriminating power for each predictor.

For "Reason" data, six of the nine factors differed across the three time periods. Figure 1 displays the magnitude of difference among time periods graphically. Notice that all of the factors differences are not in the same direction. Some, like "Mass Communication", "Alternative Education" and "Improve Teaching Effectiveness" have declined in the importance over time. Others, like "Interdisciplinarity", and "Research-Based Media Design" have increased in prominence over time. One other, "Developing Countries" increased from the first period to the second, but declined from the second to the third.

For "Concept" data, only three factors differed significantly over the three time periods. "AV Education" declined sharply in importance from period one to period two, and declined even further to period three. By contrast, "Improve Efficiency andEffectiveness of Learning" and interest in "Distance Education" increased dramatically as part of M.A. Students' conceptual basis for the field. It is interesting to note that "Systems Approach", the largest loading factor from the previous step, did not differ across time, and might therefore be considered as one of the core concepts of educational technology. Other high loading concepts which did not differ over time were: "design and development"; "philosophy for change", "instructional design"' and "learner centered methods".

Table 1. Factor Analysis and Discriminant Functions Analysis of "Reason Why I Applied to Ed. Tech" Data

Factor Analysis		Discriminant Functions Analysis				
Factors (1 - 9)	Variance (%)† Explained	Category Means (Factor Scores)			F-Ratios	
		1968-74	1975-81	1982-89	Univariate	Multivatiate
Interdisciplinary	8.9	-.39	-.19	.27	16.90	21.03*
Research-based Design and Development	8.1	-.17	-.17	.17	5.90	7.55*
Learning Theories (Applied and Research)	7.4	.01	.08	-.05	< 1	
Mass Communication (Educational Television)	6.3	.69	.02	-.29	32.66	37.27*
Developing Countries (Interest in and from)	5.6	-.21	.26	-.07	6.32	6.42*
Training for Profession	5.4	.01	-.01	.00	< 1	
Alternative Education	5.0	.10	.19	-.15	4.89	6.03*
Educational Problem Solving	4.9	.01	-.08	.04	< 1	
Improve Teaching Effectiveness	4.7	.18	.17	-.17	6.00	7.69*

†Total Variance Explained = 56% *$p < .05$ $n = 408$

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Table 2. Factor Analysis and Discriminant Functions Analysis of "Conception of Ed. Tech" Data

Factor Analysis		Discriminant Functions Analysis				
Factors (1 - 14)	Variance (%)† Explained	Category Means (Factor Scores)			F-Ratios	
		1968-74	1975-81	1982-89	Univariate	Multivatiate
Systems Approach	8.3	.05	.05	-.05	< 1	
Design and Development	5.9	-.01	.12	-.06	1.25	1.36
Philosophy for Change	5.3	-.09	-.02	.05	< 1	
A/V Education	4.9	.30	-.01	-.11	5.12	5.47*
Instructional Design	4.7	-.13	-.05	.08	1.51	1.73
Learner Centered	4.3	-.02	-.04	.02	< 1	
Improve Effiency and Effectiveness of Learning	4.1	-.33	-.32	.32	23.45	24.22*
Use of Learning Resources	3.9	-.10	-.06	.08	1.25	1.44
Communication and Information Theory	3.7	.03	-.03	.01	< 1	
Distance Education	3.6	-.12	-.16	.14	4.08	4.59*
Educational Strategies	3.4	-.11	.08	.00	< 1	
Research Based Approaches	3.4	-.14	.03	.04	1.01	1.08
Cost Effectiveness	3.2	-.04	.06	-.02	< 1	
Refining Techniques	3.2	.08	.07	-.07	1.03	1.18

†Total Variance Explained = 62% *$p < .05$ $n = 408$

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Figure 2. Difference in mean factor score ("Reason") over three time periods.

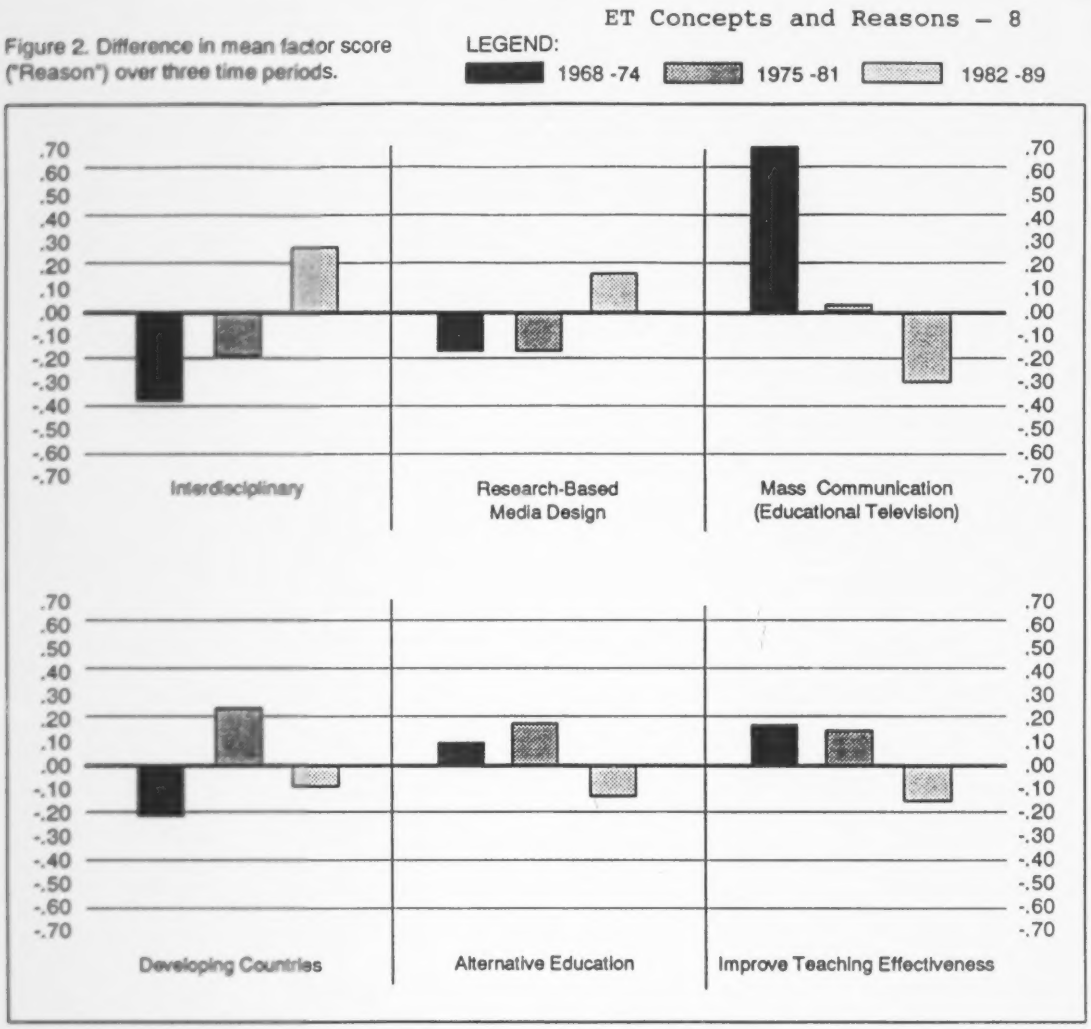
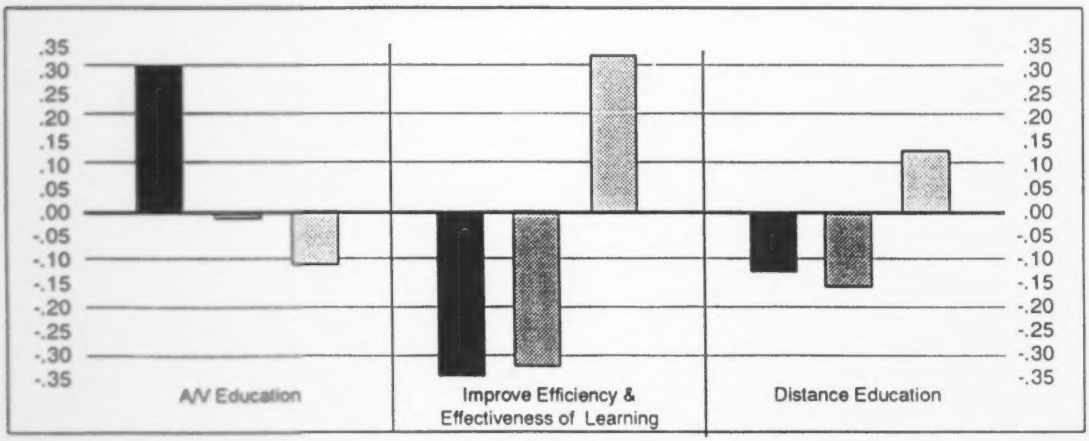


Figure 1. Difference in mean factor score ("Concept") over three time periods.



DISCUSSION

The results of the factor analysis for both "Reasons" and "Concepts" suggests that there exists an empirical structure underlying the data which can be interpreted by reference to the conceptual descriptions within the professional literature. It appears that student reasons for entering the M.A. program are consistent with the general goals of graduate study and that students' conception of educational technology, while not comprehensive, is consistent with the philosophic underpinnings of the field itself.

These comments, however, must be qualified somewhat in light of the only moderate strength of association achieved through factor analysis. In the case of both data sets, variance accounted for was distributed more equally across the primary factors than is normally considered desirable. This means that a number of clusters, roughly equally weighted, form the basis of student perception. It is arguable, however, that this diversity of student opinion is simply reflective of the variety of opinions and positions on the nature and usefulness of educational technology expressed in the literature of the field (e.g., see Hawkridge, 1981, Heinich, 1984). Similarly, Jonassen (1989) found a large set of correlated concepts related to instructional systems technology, a sub-domain of educational technology.

The analysis of "Reasons" and "Concepts" over the three time periods provides an interesting profile of changing views towards the field (see Figure 1). First, only three "Concepts" were found to change over the three time periods. Emphasis on "A/V Instruction" diminished considerably between the first and second periods, and even further in recent years. This is entirely consistent with actual trends (compare Allen, 1970 with Ely, 1988). Conversely, students indicate a rise in interest in "the efficiency and effectiveness of learning". Taken together, these results may be seen as a swing in focus, away from teacher-centered and towards learner-centered education. "Distance education" (including adult and independent learning patterns), the third factor that increased over time, is probably the result of the effect that instructional design and newer communication and learning technologies are beginning to

have on institutionalized independent learning systems such as distance education.

The change over time in "Reasons" may also be explained in light of changes that are evident in the field of educational technology. The field is becoming more interdisciplinary and there is increasing interest in research as the basis for program design and instructional development. By the same token, the once popular orientation towards mass communication/educational television has diminished significantly as the field has moved towards individualized and group-oriented models of education (Eraut, 1989).

The last three factors which differed over time may be more reflective of changing demographics in the Concordia program. The once large number of students from 'developing countries' has been reduced considerably as a result of rising international student fees. Similarly, diminished interest in "alternative educational" patterns (e.g., open classrooms, creative curriculum) and "improving teaching effectiveness" (e.g., use of A/V aids) probably resulted from the shift away from teachers as the primary audience for the program.

In summary, this study has demonstrated that students enter into graduate studies in educational technology with reasonably well defined ideas that match, to some extent, the program goals and professional values in the field. The ebb and flow of technological advances and declines is well expressed in their responses as well as the rising interest in research-based design. Educational technology is seen as a "melting pot" for various disciplinary orientations and as a reasonable input to innovative instructional approaches such as distance education and computer-based instruction.

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DISTANCE EDUCATION IN SASKATCHEWAN: SCN STYLE - EQUAL ACCESS MODEL

F. Barry Brown

INTRODUCTION

This paper will look at distance education in Saskatchewan and trace development of the Saskatchewan Communications Advanced Network (to be designated the Saskatchewan Communications Network (SCN) from its initial roots to the present. It will establish the relationship between this unique agency and the multidimensional telecommunications infrastructure in place in the province. A unique characteristic of the Saskatchewan approach to educational communications has been the degree to which the residents of the province have participated in the decision making process. It looks at the special nature of Saskatchewan's information delivery system in respect to the high degree of public input, the unique technical configuration of the network and the participatory nature of programming to be carried on the network. This process has consumed an inordinate length of time, and the jury remains out as to the efficacy of the approach. Another unique feature described will be the manner in which the existing infrastructure has been preserved and incorporated into the new mold. Attention is focused particularly upon the distance education aspects of SCN.

The paper describes telecommunications development in Saskatchewan and the role that telecommunications has played in "Bridging the Distance" between the learner and the institution of learning. It provides a cursory account of some of the deliberations and experimentation that occurred in Saskatchewan as a new technology was interfaced with an old task. The Saskatchewan experience, like its people, has been cautious and deliberate. The new provincial distance education delivery package, growing out of the satellite Uplink experiments at the University of Saskatchewan and incorporating the delivery model pioneered by the Saskatchewan Tele-Learning Association (STELLA), has potential to be of great service to the people of the province. The Saskatchewan Communications Network is premised upon public input and promises unprecedented "equal access" to information by

the public. It is a model that bears consideration when designing a telecommunications system in an area with the geographical, population and financial situation of Saskatchewan.

One strong characteristic of Saskatchewan's model for an educational communications network is that it has not superseded existing development taking place in Saskatchewan. Rather the model appears to supplement, extend, and strengthen previous efforts -- coming of age as it were. This process of maturation has added a new dimension to the potential for distance education in the province. New communications technologies introduced in Saskatchewan are rapidly moving the province toward the goal of equal access to information for every resident. Advancing into the information age for Saskatchewan residents is contingent upon articulation of several key components. Communications technology, a key component, is ripe for exploitation in the province. Information users, information providers, and information developers are in dialogue through SCN, an umbrella organization conceived as a means whereby information stakeholders are to be forged into a master matrix, to create the ideal information vehicle to see Saskatchewan residents through the decade of the 90's. Many challenges have yet to be met before the dream is realized. This paper looks at the ingredients, reviews possible recipes that may lead to success, but constitutes only an interim statement, as the real test will be in the baking.

In order to comprehend the situation facing information providers and information receivers one must gain an appreciation for the great distances, sparsity of population, rugged terrain, and disparities among population, distance and terrain existing in the province of Saskatchewan.

Saskatchewan

One of ten provinces of Canada, Saskatchewan is situated between Manitoba on the east and Alberta on the west, Northwest Territories on the north and the United States on the south. Figure 1 shows Saskatchewan as it is located on the North American continent. It is an interior province sharing with Alberta the distinction of having no boundary adjoining salt water. Saskatchewan has a population

Figure 1
SCN PROVIDES COVERAGE FOR THE ENTIRE PROVINCE OF SASKATCHEWAN

of 1,009, 613 (1986) and a geographical area of 652,000 sq. km. (252,000 sq. mi.), including 178,000 sq. km. of forested land and 81,631 sq. km. of inland water. Population density is about 1.8 per sq. km. (4 per sq. mi.) and is concentrated in the southern third of the province. Climate is continental, with cold winters and hot summers. The topography ranges from semi-arid rolling plains in the south, through the central grasslands (grain belt), to rugged Canadian Shield rock, swamp, and forest in the northern half of the province. Agriculture is the largest single industry. Other principal industries include manufacturing, mining, meat processing, petroleum refining, fishing, forestry, and electricity production.

Elementary and secondary education in Saskatchewan is carried out through a system of Protestant and Roman Catholic schools. In 1988, 948 elementary and secondary schools served 203,866 students. Post-secondary institutions include nine regional community colleges with a non-credit enrolment of 86,000 students and two universities located in the largest cities, Saskatoon and Regina, serving 20,000 students. Four technical institutes in four separate locations across the province have 7,500 full-time and 21,000 part-time students.

Roots

The roots of distance education in the province of Saskatchewan lie in programs initiated in 1910 by the Extension Department at the University of Saskatchewan. These programs were associated with the Agricultural Societies and Homemakers Clubs. The University established close ties with many provincial groups throughout Saskatchewan, providing non-degree education at a distance to mainly farm, youth, and community organizations during the early decades of this century. In 1929 the Department of Correspondence was established, and the University initiated off-campus degree courses. In 1938 an Adult Education Service was established and in 1950 colleges such as Pharmacy and Agriculture initiated professional development activities directed at their graduates in the province. The Saskatchewan Community College system began to take shape in 1972 under a directive to act as an intermediary for provision of credit and non-credit programs to Saskatchewan communities. By 1975

the Extension Division at the University of Saskatchewan had assumed responsibility for coordination of all part-time and correspondence courses with the exception of the Northern Teacher Education Program (NORTEP) and the Indian Teacher Education Program (ITEP) which remained the responsibility of the College of Education. To this point, "off-campus", independent study, and "extension" programs available to residents of Saskatchewan did not closely fit current definitions of distance education. Many programs were "offered at a distance" by face-to-face contact with travelling instructors. These programs provided an essential education service to residents isolated by Saskatchewan's vast distances and sparsity of population. Residents placed a high value on communication amongst themselves and with the province's institutions. A strong foundation was laid in the early years for what was to come.

During the 1960s and the 1970s both the University of Saskatchewan and the University of Regina began to experiment with distance education programs which qualified within the parameters of the then popular definition that distance education involved "situations where teachers and learners carry out their essential tasks apart from one another although they communicate in a variety of ways" (Daniel and Stroud, 1980, p. 1). Throughout the seventies the two universities carried out small scale telecommunications experiments involving remote teaching by telephone, by electronic remote blackboard, by slow scan television transmission and by fibre optics transmission (Fortosky, 1983, p.47-134). Satellite transmission of credit and non-credit programming began in 1981 with field trials sponsored by the federal Department of Communications. The trial at the University of Saskatchewan was code named Uplink '81. This trial and subsequent trials entitled Uplink '84 and Uplink '86 established a framework for the current telecommunications initiative in the province under the auspices of the Saskatchewan Tele-Learning Association Inc., which was formed in 1985 as a cooperative venture for delivering educational/informational programs.

During the same period of time the Saskatchewan Communications Advanced Network (SCAN) was taking shape. In 1983, Ministers of the Government of Saskatchewan were asked to appoint representatives to a Distance Education Committee. The Communications Policy Branch and the

Distance Education Committee in collaboration with the Departments of Agriculture, Culture and Recreation, Advanced Education and Manpower, Education and Saskatchewan Government Telephones conducted a year long study into the communications needs of the province. Deliberations of these agencies resulted in the writing of a white paper which culminated in public hearings held throughout the province during 1984. One hundred and twenty-one presentations were received at ten hearing sites spread across the province. There was strong public support for establishment of SCAN.

A gestation period of five years separated conception and birth of SCAN when on January 11, 1989, an Order in Council advised establishment of a new crown corporation "to undertake the creation and implementation of the Saskatchewan Communications Advanced Network" (Gazette, 1989, p.128-129). The mandate of the new corporation was to ensure that virtually everyone in Saskatchewan will have "improved access to informational, cultural, agricultural, and educational programming" (SCAN, 1989, p.1). The specific mandate of the Corporation was "to provide equal access to information to all Saskatchewan residents". The broad mandate was that, "in addition to the dissemination of public information, it will also promote the development of the communications technology and information industries in the province" (Hersche, 1989, p.1).

Fifteen months of intense activity precedes an up-coming news release, May 3, 1990, by the Minister responsible for SCAN. The Honourable Gary Lane will announce legislation creating a crown corporation called the Saskatchewan Communications Network (SCN). This milestone in telecommunications development in Saskatchewan will signal fruition of a decade long thrust to establish an equitable and efficient means to improve access to educational, cultural, and informational programming. Throughout this same period the province of Saskatchewan systematically installed a world class telecommunications infrastructure including a sophisticated fibre optics network, telephone system, and satellite network available to all residents under the provincial philosophy of "universal access" and "rate averaging" (SaskTel, 1988, p.1).

Setting the Stage: Telecommunications Development in Saskatchewan

Telecommunications in Saskatchewan was initiated in 1882, just six years after Alexander Graham Bell received the patent for the telephone. The first telephone exchange was established in Regina, the capital city, in 1887. When Saskatchewan became a province in 1905, 2000 telephones served a population of 236,000 residents. Long distance service to other provinces began in 1906. Until this time service had been predominantly urban, but in 1908 the Department of Railways, Telegraphs, and Telephones was created by the "The Railways and Telephone Department Act" permitting the department to establish, operate, administer, and expand local service in urban areas and long distance service throughout the province (SaskTel, 1988, p.2). "The Rural Telephone Act" and "The Municipal Telephone Act" permitted farmers and municipalities to form telephone companies (SaskTel, 1988, p.2). The 5,710 subscribers were served by 792 kilometres of long distance lines by 1910. By 1920 subscribers had increased to 70,000, and 8,666 kilometres of long distance pole lines had been installed. By 1950 more than 114,000 of the 830,000 Saskatchewan residents were connected. In 1966 SGT became Saskatchewan Telecommunications, and the development of full-range telecommunications services burgeoned as modern communications technologies evolved. SaskTel initiated a $90 million program to improve rural service, which involved installation of enough buried cable to circle the earth one a half times and brought service to 7000 farms in the province. The 70's concluded with 584,000 telephones serving 968,000 residents. Telephone service peaked in 1987 with 747,000 for a population barely topping 1,000,000.

Massive technological initiatives respecting telecommunications were undertaken by SaskTel during the 1980s. Foremost among these initiatives was the application of digital technology aimed at a goal of "all digital" by 1995 (SaskTel, 1988, p.10). The major milestone in establishing an all digital telecommunications network was the start of construction in 1980 of the world's longest commercial fibre optic system. This system was completed in 1984 when 52 of Saskatchewan's largest communities were connected by a 3,268 kilometre fibre optic network. The installation was initiated with multi-mode

fibre and short wavelength light with repeaters ten kilometres apart capable of 672 telephone conversations per pair of fibres. Innovations quickly increased the fibre capacity for the final portion of the installation. Long wavelength light, wavelength division multiplexing, single mode fibre, and a higher transmission speed increased the capacity to 2000 telephone conversations on multi-mode and 8000 conversations on single-mode per fibre pair with repeaters spaced 30 kilometres apart. Each fibre pair is capable of at least six video (TV) channels or 135 million bits per second or any combination simultaneously. The fibre optic network connects with more than 7,000,000 kilometres of buried cable and wire and 4,500 kilometres of coaxial cable serving 900 communities in an area encompassing 650,000 square kilometres.

The Corporation's stated mandate indicates that "SaskTel is committed to meeting the ever-changing information handling requirements of all Saskatchewan residents, now and in the future. As an innovative leader in the telecommunications industry, the corporation continues to provide quality, reasonably priced services by applying the latest technological advances in the most economical way" (SaskTel, 1987, p.37). SaskTel has committed itself to the following: "As Saskatchewan advances into the information age, SaskTel will continue to fulfil its mission of being the partner of choice for all telecommunications needs throughout the province. By applying the latest technological advances in the most efficient way possible, Saskatchewan residents will be able to choose from an ever-widening choice of new products and services" (SaskTel, 1988, p.3).

SaskTel as a provincial Crown Corporation has held a virtual monopoly on provision of telecommunications services to the residents of Saskatchewan. This monopoly has been in a double edged sword in that it has given the telephone company the stability, financial resources, and mandate to develop one of the world's best information systems for the residents of the province. However, on the other hand it has not restricted itself to merely moving information but has a record of controlling or attempting to control the content being delivered. SaskTel has never been able to maintain an arm's length relationship with the information providers in the province. Many information providers have been

sister corporations or other government departments. It is somewhat ironic that Saskatchewan boasts a world class delivery system but has been unable to drive the system with educational, cultural, and informational content. Saskatchewan is enormously rich in telecommunications technology but extremely poor in the area of applications.

In spite of the uneasy relationship some agencies have experienced while being the "partner of choice" with SaskTel, the corporation has an impressive record of technological firsts and has led in so many industry innovations that they cannot be outlined here in their entirety. Among the noteworthy telecommunications firsts that have directly influenced education in the province is the 3268 kilometre fibre optics system. The extent of the fibre system can be visualized in Figure 2 which traces the fibre which links 52 Saskatchewan communities in the Southern half of the province. Fibre is restricted to this portion since the Northern half of the province consists of exposed bedrock. In order to serve this part of the province SaskTel installed North/South microwave systems capable of voice and data transmission. Television for the north half of the province is being delivered by Telesat Canada satellite. Educational television is delivered by a combination of fibre and satellite on the Ku band. SaskTel views ISDN as the "key that will open the door to universal Information Age Services" (SaskTel, 1987, p.11) and will be "all digital" installed across the province by 1995. Others in the province take a more pessimistic view, feeling ISDN is a telco motto for "I see dollars now". Field trials seeking to exploit the potential of ISDN are contemplated to begin in September 1990.

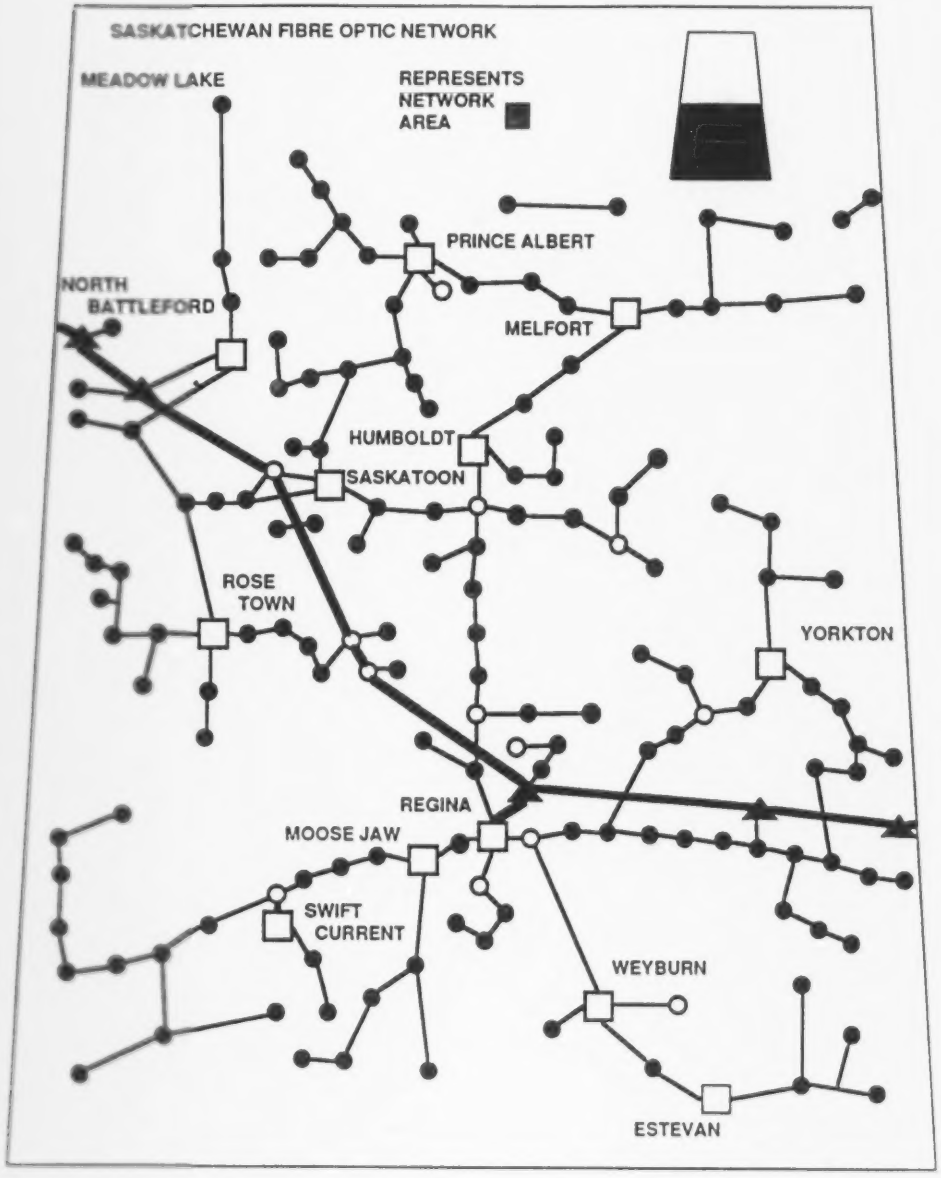

Figure 2
SASKATCHEWAN'S 3268 KILOMETRE FIBRE OPTIC NETWORK

Another first for SaskTel that holds great promise for the residents is a "Video-on-Demand" trial which employs the "world's first field installation of a DFB laser derived AM-VSB analog fibre optic video to a trunk bridger amplifier feeding 144 cable subscribers and one school through coax distribution" (Bradley, 1989, p.1). Video-on-Demand has been dubbed the "video jukebox", and by simply dialling a number on a touch-tone telephone teachers can access 100 educational videotapes loaded into VCRs at the switching station. The selected video appears on a screen in the classroom within one minute. A new cost-reduced fibre optics transmit/receive mechanism called "linear Photonics" is making the service possible. SaskTel hopes to install a "network that will link every classroom in the city [Regina, 175,000 residents] to a giant central database connecting the schools with fibre optics and centralizing audio-visual programs in one facility" (SaskTel, 1988, p.1).

Telecommunications has been a major aspect of the lives of Saskatchewan residents for more than a century. The beginning of the second century appears to hold great promise. This promise is embodied in a new Crown Corporation, called the Saskatchewan Communications Network (SCN) created as an infrastructure to "encourage, facilitate and coordinate the use of communications technology in Saskatchewan" (Kyle, 1985, p.17). Enabling legislation for SCAN was created more than a year ago, and a group called SCAN has been operating under the auspices of the Minister responsible for SaskTel. Once legislation creating, SCN the Crown Corporation, has passed, potential exists for an arm's length relationship with SaskTel through a representative board of directors. The foregoing gives a succinct picture of the telecommunications structure in the province of Saskatchewan. That which follows outlines the events leading to the present day status of distance education in the province.

A Decade of Development

A decade of development preceded the current implementation of SCN. Although SCAN was formally initiated by a White Paper of the same name it will be useful to establish a historical perspective

by commenting on selected events which led to distribution of that paper. In the late 1970s Saskatchewan educators were becoming increasingly interested in the potential of educational technology as a solution to some of the concerns facing education. Population shifts and declining enrolments in the rural areas made it difficult for small schools to ensure quality of education and equality of opportunity. Pressure to increase qualification swelled enrolments of post-secondary institutions. Desire for delivery of vocational and university training to areas of the province not serviced by existing institutions was mounting. Realization that a need existed for retraining and vocational upgrading was surfacing. Educators were beginning to take technological initiatives, establishing ad hoc pockets of technology in local jurisdictions. The technological imagination of the province's educators was fired by the installation of a fibre optics delivery system throughout the province. Results of early experiments using technological means for delivering instruction to remote sites were inconclusive (Brown, 1989, p. 454-459). For the most part the approach worked but the success was almost exclusively related to the individual efforts of a dedicated instructor. Few of the early efforts could be generalized to other instructors, due to the increased work load involved and the lack of organized long term institutional support. Reaction of instructors was generally that it would be easier to jump in the car and travel to the location to conduct a face-to-face session. Dunleavy (1988) alludes to the need for support in the case he makes for learning centres: "There are a number of problems with distance education, such as mastering the technology, developing the appropriate teaching tools, and managing program delivery. Usually course content and delivery claims more attention than the learner. Most distance education institutions have encountered high drop-out rates and have attempted to remedy this by trying to address the learner's needs. A learner focus can make a difference" (Dunleavy, 1988, p. 93).

The marriage of television (audio and video), telephone (interaction) and satellite (large scale distribution to small client groups) seemed to hold promise as an ideal solution for many of the ills that plagued distance education undertakings in the past. A group of educators at the University of

Saskatchewan applied for federal funding to use Telesat Canada's "seat sale" on "by the hour" space segment time. This group, directed by Danielle Fortosky of the Division of Audiovisual Services, mounted Saskatchewan's first project involving delivery of instructional programming by satellite. This project was entitled "Uplink '81" (Fortosky, 1984, p. 2). The inaugural Uplink planning group saw satellite transmission as an ideal way to supplement provision of off-campus courses and programs. This in turn generated more ambitious projects entitled Uplink '84 and "Uplink '86".

During the early satellite experiments educators looked to the Department of Education for guidance as to actual and potential uses of educational technology. In an effort to react to the increasing pressure to use technology in education the Department initiated a study entitled "Communication Technologies in Education Project" in May, 1981. A 14 person steering committee was established to provide "philosophical and practical direction for the project" (SaskEd., 1983, p.5). This committee included participants from Communications, Education, Continuing Education, Culture and Youth, Agriculture, SaskTel, SaskComp, SaskMedia, University of Saskatchewan and University of Regina. It was directed to identify current issues, alternative courses of action, and suggest policy directions (SaskEd., 1983, p.6).

In respect to telecommunications the report specified: "To be financially viable the (telecommunications) system would have to be a co-operative project involving several agencies" (SaskEd, 1983, p.32). A smaller working group was formed to study the issues and develop a document which would be of assistance to all concerned with distance education. The Provincial Distance Education Working Group was established in May, 1981, (Benson, 1982, p.ii). This group arrived at ten major conclusions which pointed out the potential for communications technologies, laid out six recommendations for action, and six new directions to follow for the Government of Saskatchewan (Benson, 1982, p.ii-iv). The committee concluded that a "Provincial Distance Education Network" be formed for the development and delivery of services (Benson,1982, p.56). The group further specified the task by indicating that the "Network" recommended be defined "in both human

terms, as the means to bring together and catalyze appropriate actors in the public and private sectors, and in hardware terms, as the communications highways and appropriate use of such highways in the public interest" (Benson,1982, p.56).

A number of other agencies and institutions, public and private, were, during this same time period, contemplating their needs as anticipated by the new technologies and the fibre optics network. For the most part the majority of educational thinking is reflected in the work of the two groups mentioned above. Business and industry, although vitally interested in the potential of the fibre optic network for information transfer, tended to be complacent concerning the educational and training potential of the new technologies. A number of concurrent activities were initiated during the period following tabling of the reports from the Department of Education and the Provincial Distance Education Working Group. The Communications Policy Branch began an extensive year-long study into the communications needs of the province. The post-secondary educational institutions began several local initiatives in provision of delivery services for distance education. The most notable of these was the response of the University of Saskatchewan to the satellite experiments sponsored by the Federal Department of Communications which culminated in Uplink '81 and Uplink '84 in which a number of post-secondary institutions participated to deliver educational programming by satellite (Brown, 1989, p.454). The University of Regina began experiments delivering credit courses to remote sites using the fibre optics network. Experiments using slow scan television, teleconferencing, computer conferencing, and broadcast television were attempted. No major province-wide sustained initiatives resulted until the formation of the Saskatchewan Tele-Learning Association Inc. in late 1986 (Brown, 1989, p.457).

At about the same time the Department of Advanced Education and Manpower began to draft policy directed toward Distance Education Projects which "improve accessibility to programs and services in post-secondary education for all citizens of Saskatchewan" (Sask. Advanced Education, p.1). In an undated "draft" policy statement the Department indicated that funds may be forthcoming to support Distance Education Project initiatives which:

(1) research, integrate and apply theoretical and perceptual perspectives in practical situations;
(2) lead to organizational or institutional improvements that have potential for system-wide application;
(3) promote involvement of other government departments, agencies and the private sector;
(4) encourage inter-institutional cooperation in development and testing of new delivery methods; and,
(5) can be sustained financially over a long term and integrated into regular institutional operations (Sask. Advanced Education, p.1).

Fired by numerous reports, the possibility of funding, various experiments, and a great deal of technological optimism the citizens and educators of the province were highly enthusiastic about the announcement on April 13, 1984 by Saskatchewan Communications Minister the Honourable Gary Lane that "residents will soon have the opportunity to respond to a government white paper proposing the creation of a Saskatchewan Communications Advanced Network" (Lane, 1984, p.2).

Scan White Paper

The news release accompanying the SCAN proposal announced that the new network would carry a variety of communications services to the public, including community television, cultural information, educational services, and access to computer data bases. The news release went on to indicate that the Communications Policy Branch in collaboration with the Departments of Agriculture, Culture and Recreation, Advanced Education and Manpower, Education, and SaskTel had conducted a year-long study into the communications needs of the province. The Minister announced that the study had resulted in a white paper which would culminate in public hearings to be held throughout the province. He went on to assure the public that they would be given every opportunity to comment on SCAN's desirability. He said "since SCAN had the potential to further development of an information industry in Saskatchewan and provide the province's citizens with new learning opportunities, the public must be given every opportunity to express its views on the white paper" (Lane, 1984, p.3).

The text of the white paper contained an open letter from Gary Lane, the Minister responsible for Communications, expressing his desire to involve the public in the decision to create an advanced

network. The content of that letter contributed to what can only be described as a phenomenal response to the proposal. Gary Lane invited people of the province to become actively involved in the formative stages of a proposal to satisfy the "many educational and cultural needs of Saskatchewan residents" (Lane, 1984, p.ii).

The objective of the white paper was to describe SCAN and its potential to the public and to solicit public reaction to the SCAN proposal. A brief historical overview described developments leading up to the proposal. The paper went on to describe the physical and organizational composition of SCAN, set out its limitations and explained how views were to be made known. The paper pointed out that SCAN initially would be carried on the provincial telephone system and SaskTel's fibre optic cable network or Broadband Network (BBN). The telephone network would reach all the province's communities with some form of information communications. As the BBN would reach fifty-two communities by the end of 1984, approximately sixty percent of the province's population could have access to the full services of SCAN. SCAN services would be delivered by:

(1) specialized television: educational, informational and cultural programming would be available to anyone on the cable television network;

(2) telephone conferencing: interaction between groups would be a possibility wherever the telephone system reaches;

(3) information data banks: could be accessed from anywhere on the telephone system through use of specialized equipment.

It would be possible for these technologies to be used individually, or in conjunction with one another. A live televised presentation originating in one community could, for example, be carried either to all or to select communities on the BBN, while the viewing audience might be linked via telephone conferencing to facilitate questions and discussion. In certain communities served by the network, specialized SCAN centres could be established for the purpose of providing easier access to otherwise unavailable services. All the equipment necessary to conduct meetings, including data access terminals, telephone conferencing equipment and television receivers, could be supplied at such centres (Lane, 1984, p.3).

It was proposed that administration of the network be provided by an "arm's length" public agency responsible to the Crown. This type of arrangement would allow SCAN to be responsible to the public and be fully objective in its dealings with users. The SCAN agency would seek access to the designated educational channels on cable television and negotiate a "rate" with SaskTel for use of the telecommunications network. The primary function of the agency would be administration of the network. Groups, non-profit organizations, government departments, universities and community colleges could apply to the agency for access to the network facilities. To ensure optimal utilization it was proposed that the agency would be responsible for effective scheduling of unused network time to provide programming continuity and to service groups with special information needs.

The white paper foresaw the following individuals benefiting from the SCAN services:

- members of Saskatchewan's arts and cultural organizations, who could employ SCAN services to exchange information and provide a common cultural experience to an expanded audience;
- volunteer organizations;
- senior citizens, who could view television programs advising them of special health care services;
- farmers and ranchers;
- professionals who could hold meetings linked via telephone conference with colleagues in other SCAN centres;
- those wishing to upgrade their skills without travelling long distances to seminars;
- kindergarten to grade 12 students, who could receive network television programming during school days; and,
- students, who could take sections of, or entire credit courses, without having to leave homes or jobs to relocate in distant cities, as instruction could be received at home (or at a local SCAN centre) through network services, i.e. television, telephone conferencing or videotext (Lane,1984,p.5).

The proposal cited several other benefits of SCAN:

> The long term saving in time and money which could be realized through enhanced information transmission.
>
> The traditional practice of constructing schools and supplying teachers to train people is expensive, and the use of space and time is not necessarily efficient. However, it has been estimated that sixty percent of certain trades courses could be taught outside the traditional school by using techniques such as television, videotext and telephone conferencing or some combination of these technologies. SCAN, therefore, could be of considerable benefit to those students wishing to take advantage of the Saskatchewan Government's initiative to increase training opportunities for technical-skilled workers.
>
> The often prohibitive cost of travelling to a larger centre for further education would be reduced, as a network could improve access to educational opportunities by expanding the choice of courses available in smaller communities.
>
> The realm of arts and culture also would benefit from SCAN, as Saskatchewan's artists, writers, performers and producers discovered new markets for their work through expanded opportunities.
>
> The potential also exists for SCAN to be the catalyst for the development of an information industry. The network, as a market for high quality educational materials, could encourage the systematic gathering, packaging and distribution of Saskatchewan's recognized expertise in agriculture, mining, administration and the arts (Lane,1984,p.5-6).

Saskatchewan residents were invited to share their views of the proposed network before a hearing committee by submitting a written brief, delivering an oral presentation, or submitting a written brief summarized in an oral presentation at a hearing. The hearings were to take place from October 15 to November 16, 1984. Mr. Wayne D. Kyle was appointed by the Minister to chair a five person hearing committee and to conduct hearings in ten locations across the province: Regina, Estevan, Yorkton, Tisdale, Humboldt, Swift Current, Prince Albert, LaRonge, North Battleford and Saskatoon. Public response to the proposal was expressed in 121 submissions in seven broad areas: education, culture and heritage, health, agriculture, production and communication, libraries, and associations. Support for the proposal was voiced in 83% of the presentations.

Based on the content of the presentations, public comment, and lengthy discussion, the hearing committee concluded that:

1. The Government of Saskatchewan should establish the Saskatchewan Communications Advanced Network (SCAN) and proceed in the following manner:

1.1. Design a system and, with appropriate consultation, obtain feedback on the design and make suitable revisions prior to implementation. The design should include descriptions of and cost estimates for a headquarters, pilot SCAN centres, appropriate interfaces with existing organizations, management structures, production facilities, budget requirements, program cost estimates and other identifiable operational requirements (Kyle, 1985, p.17).

The design also should:

1.1.1 outline proposals for the extension of the full range of SCAN services to the entire province.

1.1.2 identify operating educational communications systems elsewhere which should be examined with a view to determining how best to proceed with implementation in Saskatchewan.

1.1.3 identify operating prototypes within the province which should be considered in the design and which may be used to illustrate typical SCAN services to the public.

1.1.4 include an investigation of the feasibility of appropriate methods of attracting production capital from various sectors.

1.1.5 utilize and permit development of all modes of communications technology and ensure consistency and compatibility of technology wherever possible.

1.2 Stimulate the production of Saskatchewan oriented materials for data banks, educational/cultural television and teleconferencing through the provision of seed money.

1.3 Commence liaison with all agencies involved with the provision of educational, cultural and communication services.

2. Consideration should be given to a statement of purpose for the system such as the following:To encourage, facilitate and coordinate the use of communications technology in Saskatchewan in order to enhance the development and delivery of educational, informational and cultural programs for the improvement of human and economic resources.

3. The Saskatchewan Communications Advance Network should be created by an act of the Saskatchewan Legislature and be responsible to the Legislature through a Minister of the Crown:

3.1 It must have autonomy but should be held accountable to the Minister.

3.2 A board of directors created under the authority of the Act should have representation from educational, cultural, industrial, labour, Indian, Native, and agricultural communities. It should also have some members appointed at large with the total membership not to exceed fifteen.

3.3 Regional advisory boards with regional representation should be established. These would provide input to the central board and exercise influence over regional matters.

4. Public access to the network should be safeguarded with regulations ensuring input to policy making, scheduling, production, use of media tools and planning. Ongoing response and feedback are imperative.

5. Provincial funding, particularly at the implementation stage, is necessary. The system may have the potential to become financially self-sufficient.

6. The specific functions of SCAN should include:

6.1 Providing a gateway to electronic "highways" in the province for

informational, educational and cultural purposes.

6.2 Coordinating and facilitating roles among users and providers of information and communications services in Saskatchewan where electronic technology would be useful for informational, educational and cultural purposes.

6.3 Creating the atmosphere and opportunities for institutions, organizations and individuals to utilize the network better, faster and more efficient services.

6.4 Fostering the development of distance education in Saskatchewan.

6.5 Promoting and sponsoring training programs for users and providers of services.

6.6 Conducting ongoing evaluation of SCAN services.

6.7 Ensuring standards for technical quality and transmission of programs.

7. SCAN must develop a harmonious and productive relationship with many institutions and organizations in the province. These include the library system, education system, health system, government departments, crown corporations and many other associations and organizations. Utilization of existing systems and resources, as much as possible, should be a fundamental operating principle.

8. SCAN centres should be established throughout the province. The board and regional advisory boards should identify locations for these.

9. SCAN should become a catalyst and clearing house for research and development in the communications and information industry (Kyle, 1985, p.17-19).

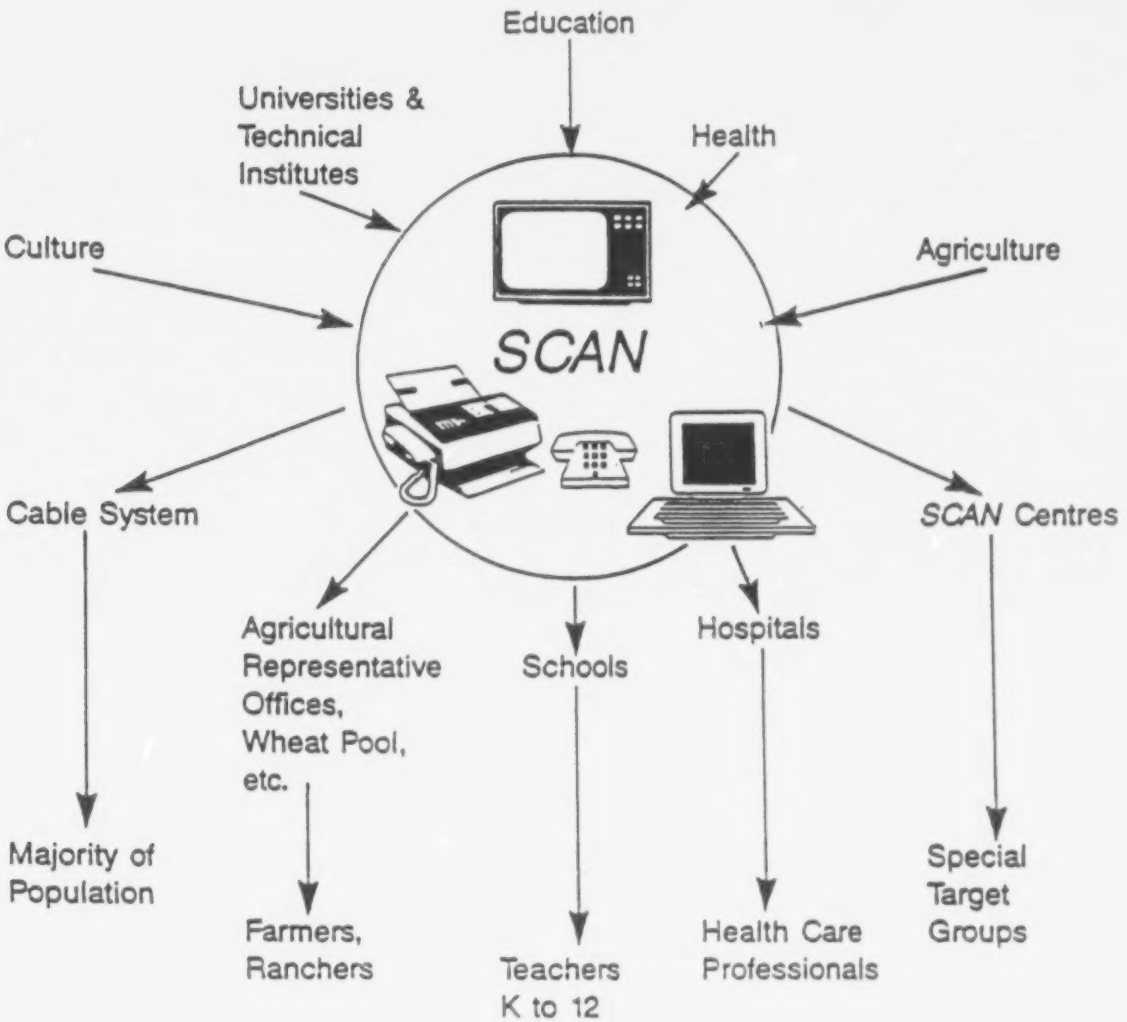

Figure 3
SASKATCHEWAN COMMUNICATIONS NETWORK
EQUAL ACCESS TO INFORMATION FOR ALL RESIDENTS OF SASKATCHEWAN

Saskatchewan Communications Advanced Network

The report of the SCAN Public Hearing Committee was transmitted to the Honourable Gary Lane, on March 5, 1985. The report languished in the Communications Policy Branch until January 11, 1989 when an Order in Council proclaimed the formation of a Board of Directors to co-ordinate the creation and implementation of the Saskatchewan Communications Advanced Network as a Crown Corporation. Thus after a gestation period of almost five years SCAN is closer to reality, although the legislation has yet to pass the House in spite of the fact that more than a year has elapsed since the Order in Council. Announced formally at the end of May, 1989 in conjunction with the Global Agricultural Technology Exposition (GATE), SCAN has made impressive progress during the last ten months even though it does not exist as a truly legal entity. Legislation and a formal announcement of the Saskatchewan Communications Network is scheduled for release on May 3, 1990.

Armed with carefully considered guidelines cited in the Kyle report and the findings of the earlier reports which triggered the white paper, the SCAN organization is making progress, realizing a number of the specific recommendations. SCAN has established as its specific mandate "to provide equal access to information to all Saskatchewan residents" (Hersche, 1989, p.1). In a news release announcing SCAN the Minister confirmed the intention to serve all the residents of Saskatchewan:

> There currently exists within the province a billion dollar telecommunications network. We are establishing a network not only for television delivery, but also for telephone conferencing and computer networking. The SCAN proposal is to establish one highly sophisticated shared-use system to be used by the government, non-profit and business sectors for delivery of programming to widely dispersed audiences. The network will expand educational opportunities throughout the province, and provide rural residents with the same access to information as is currently available to people in the urban settings (Lane, 1989, p.2).

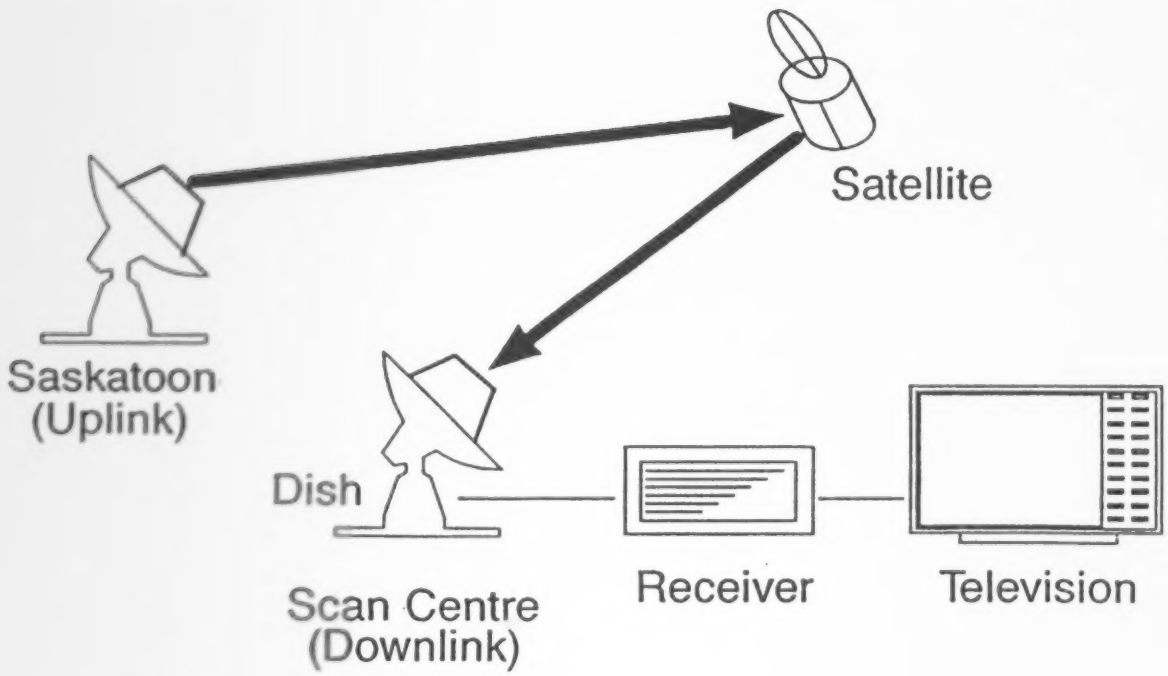

Figure 4
TELSTAT CANADA'S ANIK C SATELLITE WILL DISTRIBUTE PROGRAMS TO SCAN CENTRES NOT SERVED BY FIBRE OPTICS

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Narrowcast Network

In order to achieve this aim SCAN has undertaken construction of three inter-related networks: Narrowcast Network, Public Broadcast Network, and Data Network. The Narrowcast Network is presently providing programming. SCAN and STELLA amalgamated July 1,1989 with SCAN assuming responsibility for operation of the existing STELLA satellite distribution system and the 33 former STELLA Centres (two SCAN Centres opened in 1989 for a total of 35 centres). STELLA has assumed a revised role which includes stimulation, development, and coordination of distance education in Saskatchewan (Rudichuk, 1989, p.1). In the spring of 1989 the distance education delivery model developed by STELLA was "assessed by the Director of International Business for Ford Aerospace as one of the top 10 concepts in the world" (Hersche, 1989, p.2). (An overview of STELLA can be found in Brown, 1989, p.459-462, Rudichuck, 1989, p.1-3, and a full evaluation of STELLA's programs can be found in Asmuss, 1989; Scissons, 1984; Wagner, 1988; p. 315-319; Wong, 1988; and Wong, 1989) SCAN is committed to maintaining the forefront in delivery of distance education to the residents of the province. Specifically the Corporation has:

- negotiated a series of contracts with Regional Colleges to maintain and to operate these centres on its behalf;
- provided a consistent and reliable equipment maintenance and operational base for SCAN Centres. Participants in all centres have access to live, interactive televised programs (one-way video, two-audio), audio-teleconferencing, and facsimile machines to facilitate and enhance communication with resource personnel;
- developed a centralized 24 hour, help line for technological problems in SCAN Centres throughout the province and to provide contacts for needed local maintenance for SCAN's equipment.
- established communication with the K-12 sector to instigate three pilot projects aimed at extending and broadening curriculum opportunities to outlying, small, and multi-graded schools via the network (Oliver, 1990, p.2-3)

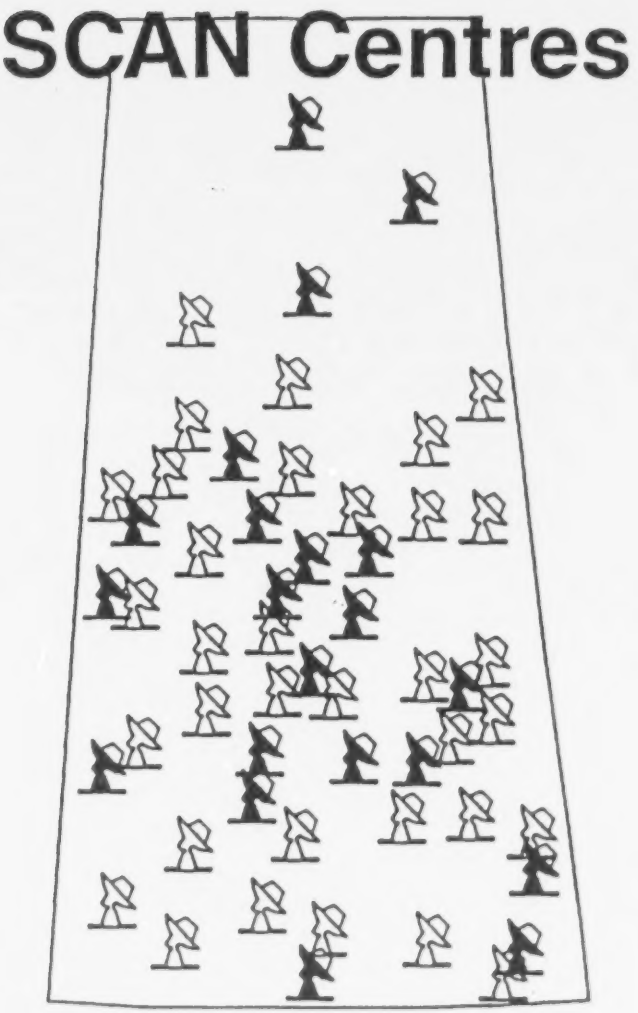

Figure 5
SCAN CENTRES ARE LOCATED IN 35 COMMUNITIES

During 1990 the SCAN Centres will be increased from 35 to 56 to increase cost effectiveness for rural students, and will increase to 100 over the next five years. Plans also call for provision of more than one simultaneous satellite signal to permit marketing the Narrowcast service to the business sector. A scrambler/descrambler is contemplated for each Centre to assure a secure signal to commercial clients and health care agencies. Funding negotiations with the Federal Government include purchase of 400 satellite dishes to provide rural schools not on the cable system with the opportunity to receive SCAN programming. A Saskatchewan company has initiated production of commercial quality dishes to service this need. Another Saskatchewan company was awarded the contract to service up-link equipment.

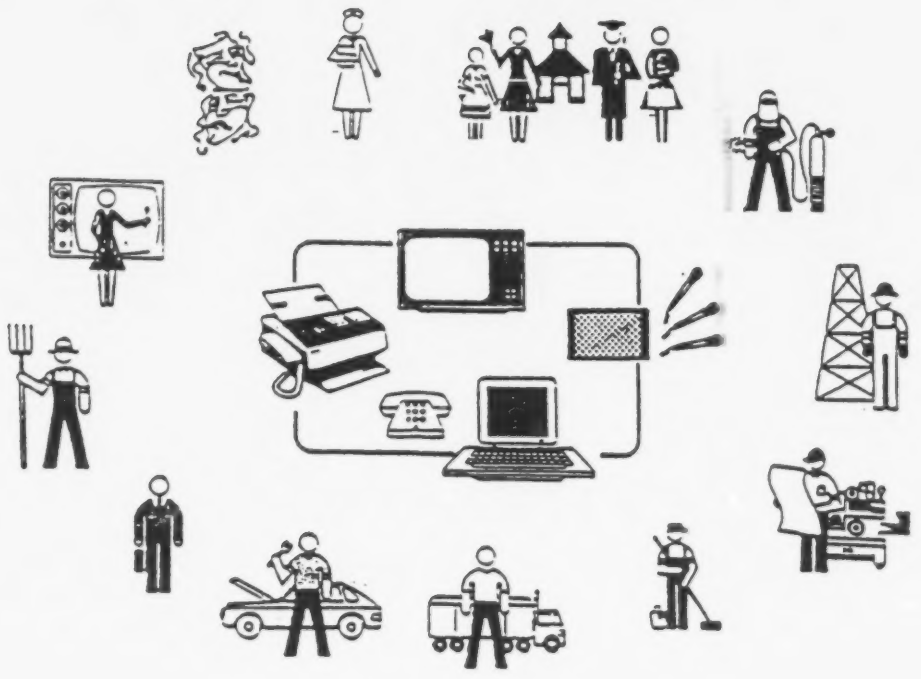

Figure 6
EACH SCAN CENTRE WILL BE EQUIPPED AS AN "ELECTRONIC CLASSROOM" WITH LARGE SCREEN TELEVISION, COMPUTER TERMINALS, TELEPHONE CONFERENCE EQUIPMENT, FAX MACHINE, AUDIOVISUAL AND CLASSROOM EQUIPMENT

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Public Broadcast Network

A programming and technological infrastructure is under development for the SCAN Public Broadcast Network (PBN). The PBN will provide for a range of educational and informational programming over the existing cable television system. Over 178,000 provincial households will receive a range of alternate programming directed specifically to the needs of Saskatchewan residents. The network was originally to begin programming January 1, 1990, but this date has now been revised forward to September. In establishing the PBN, SCAN has:

- constructed a two channel satellite uplinking station at the University of Saskatchewan;
- entered into a contract with the University of Saskatchewan to provide tape playback and distribution services for SCAN;
- developed a fibre optics and microwave network which will allow for originating signals from Moose Jaw, Regina, Saskatoon and Prince Albert;
- offered a grant of $2,000 to each of the small rural cable television licensees to assist the purchase of a satellite dish to receive and distribute the SCAN signal (Hersche, 1989, p.2).

PBN will provide early childhood programming, curriculum related programs for kindergarten to grade twelve, enrichment for credit-related courses offered on the narrowcast network, and programs designed to provide informal learning experiences for a general viewing audience. Financial efficiency will be achieved by full interrelationship of narrowcast and public broadcast networks. Canadian productions will be emphasized with first priority given to Saskatchewan programming. SCN has provided support for the Saskatchewan's private and educational production agencies by underwriting, subsidizing, and originating production direction.

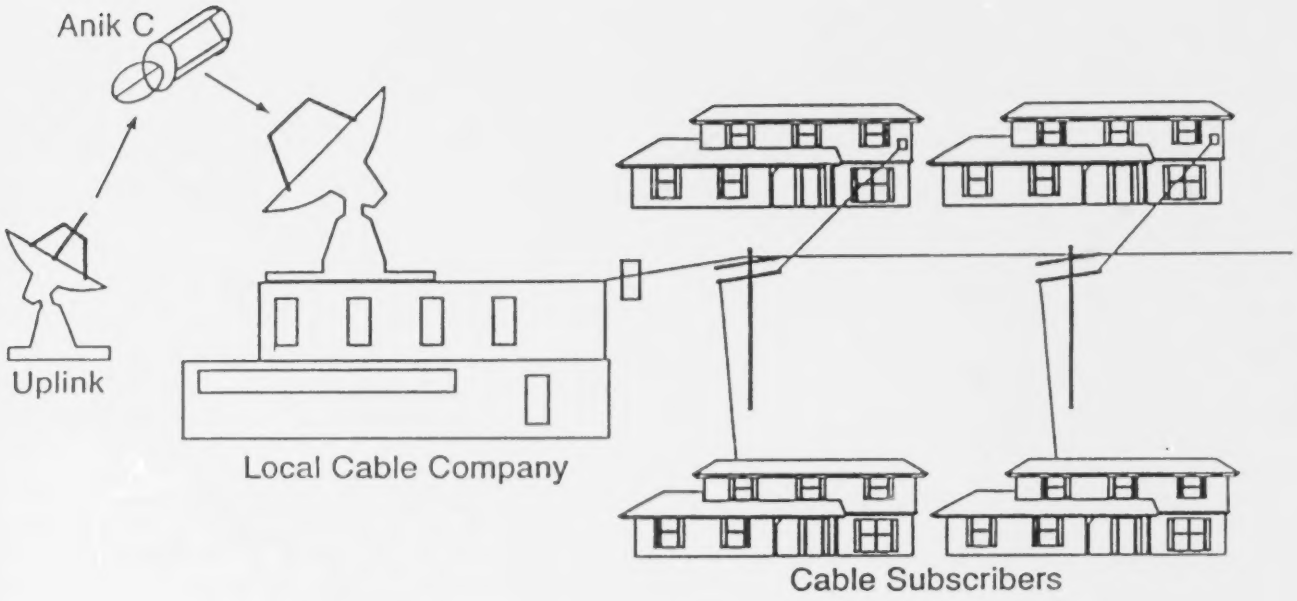

Figure 7
PUBLIC INFORMATION "ALTERNATE" PROGRAMMING
WILL BE DISTRIBUTED TO LOCAL CABLE COMPANIES
VIA SATELLITE

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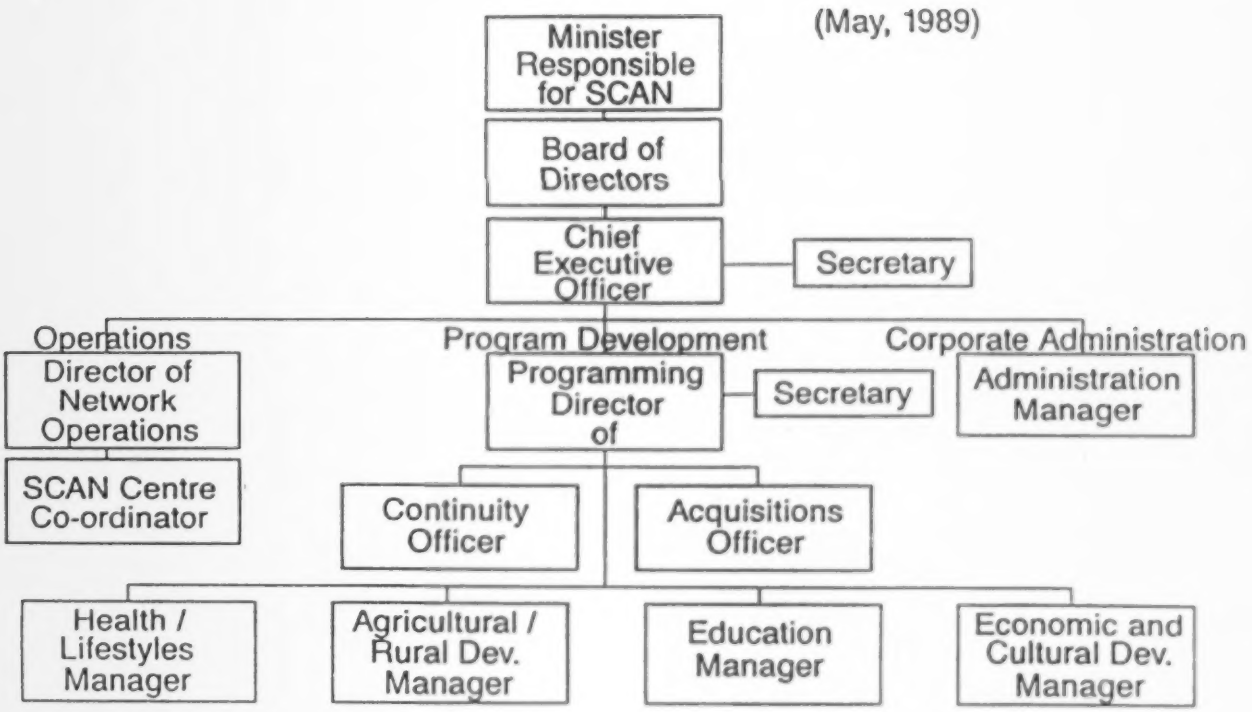

Figure 8
THE ORGANIZATIONAL STRUCTURE CONTEMPLATED FOR SCN ONCE THE CROWN CORPORATION HAS BEEN CREATED

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Funding

Funding for implementation of SCAN is in part the result of a Federal/Provincial funding agreement to encourage Saskatchewan's innovative approach in the development and application of advanced communications technologies and services. The total agreement with the Federal Government is $17-18 million over five years (Lane, 1989, p.2). The provincial Government has committed funds to bring SCAN expenditures above the $5 million level per year for the next five years. PBN will air programming in four major theme areas: "Health, Lifestyles and the Family; Agriculture and Rural Development; Education and Lifelong Learning; and Economic and Cultural Development" (Ewert, 1989, p.1). A Program Manager is responsible for each of the four areas. SCAN expects programming funds will be assigned: "In principle, SCAN will direct 50% of all available program funding to acquisitions with the remaining 50% being directed to Saskatchewan productions. The approximately 50% of available programming funds invested in Saskatchewan production will result in approximately 15% of the total programming time. It will, however, result in considerable support for the budding film industry in the province and generate direct economic spin-offs within the Saskatchewan economy. Already many Saskatchewan producers are considering capital investment to take advantage of the opportunity SCAN presents.

> The major thrust of SCN programming will continue to be in the education sector. Over two million dollars for program acquisitions, productions, and delivery of education courses were committed in 1989/90 on both Narrowcast and Public Information systems. SCN is in the process of providing the technological expertise and hardware enhancements to conduct pilot projects in high school distance education. The pilots will be designed in conjunction with producing and receiving schools and will utilize a range of teleconferencing techniques. Overall, SCN will work closely with various government departments, non-profit organizations, and advisory committees to ensure

that the programming on the respective networks reflects the requirements of Saskatchewan residents (Oliver, 1990, p.5).

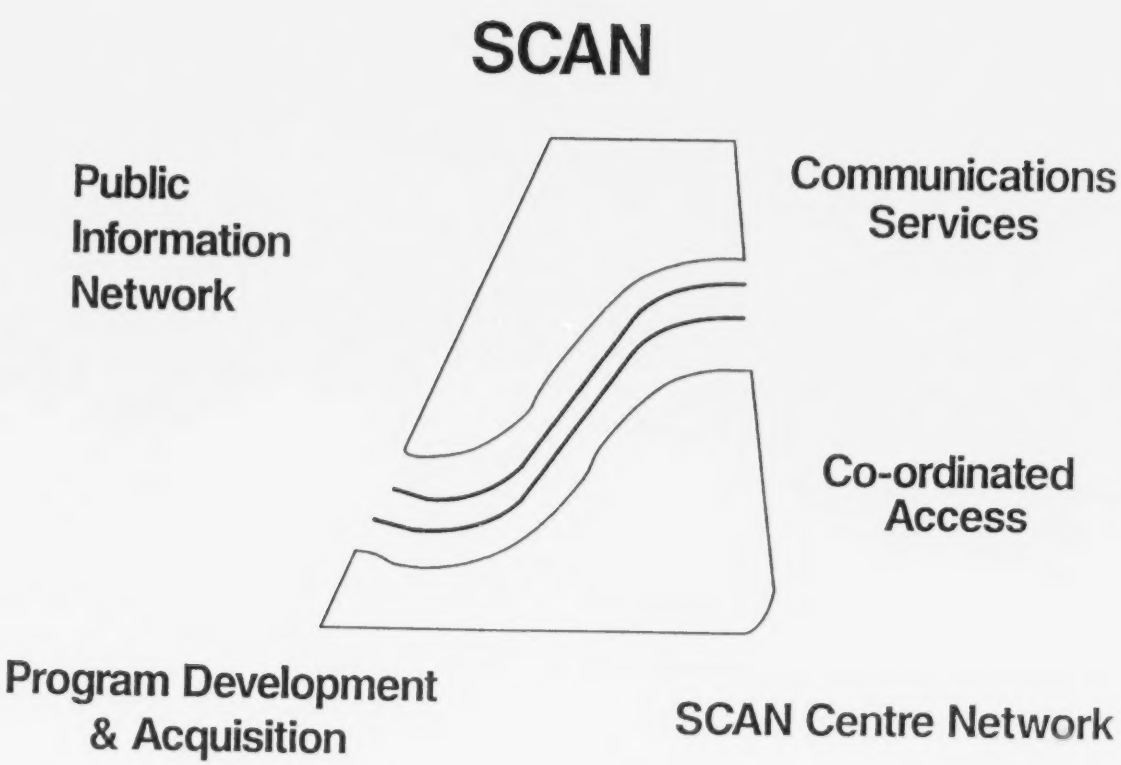

Figure 9
SCAN COMMUNICATIONS SERVICES

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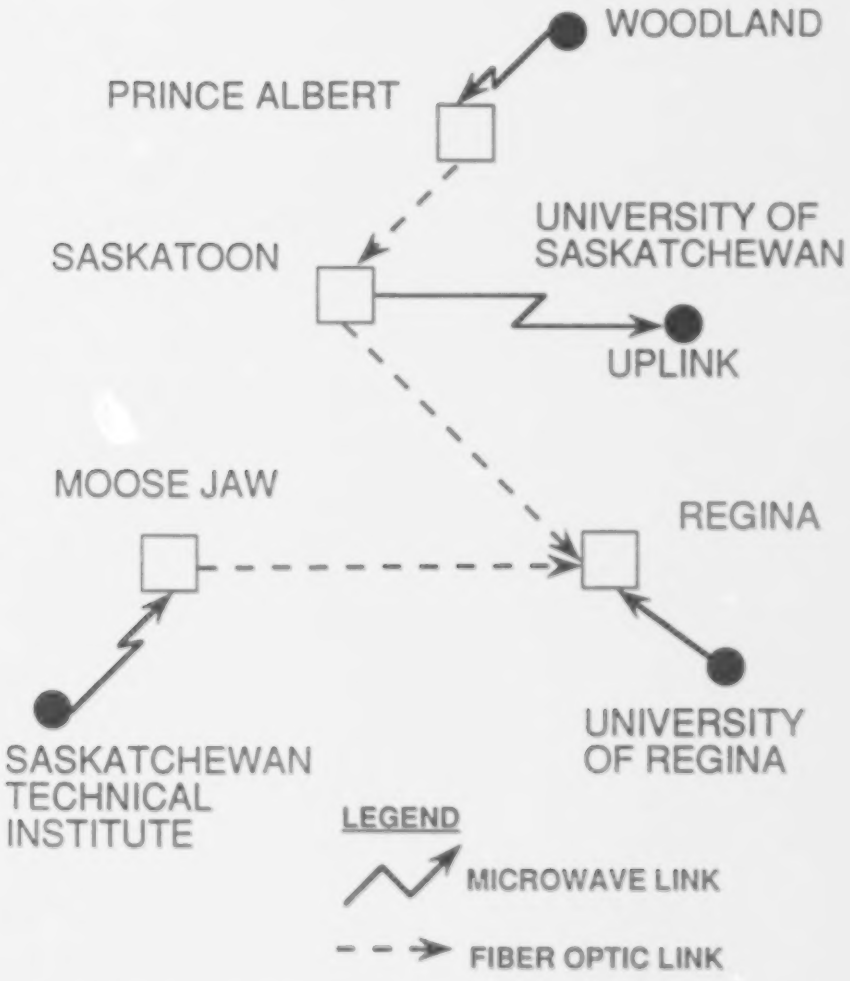
Data Network

SCAN has committed itself to a multi-mode delivery strategy. The Minister stated, "by making a variety of communications services available, SCAN will enable user agencies to deliver programming in the most suitable and cost-effective way" (Lane, 1989, p.7). Consumer data, access to library resources, agricultural information, and current health information was cited as being facilitated through increased access by the general public to computer data bases. SCAN is initially planning one computer for each Centre. Emphasis will be placed on development of software which will allow residents with limited knowledge of computer technology to access data. SCAN foresees the DATA Network now under development will:

> Provide an alternate medium for the delivery of distance education programs as opposed to the total reliance upon the more expensive video/satellite based system. As an example rural communities in Southern Saskatchewan will be able to receive competency based learning programs produced by Woodlands Campus in Prince Albert. Currently only selected northern communities receive this programming.
>
> Provide public access to various public and departmental data bases. There are a number of data bases such as the Western Procurement system and the Western Information Network to which the Economic Development departments of the province would like to provide public access. As small business becomes familiar with the economic advantages of these systems, it is anticipated that they will begin to develop their own access points.
>
> Enhance communications within the Narrowcast Network through the use of electronic mail for coordinators, the distribution of scheduling information, and electronic bulletin

> boards. This will increase the effectiveness of the narrowcast system throughout the province as well as reduce long term operational costs stemming from over utilization of the phone system (Hersche, 1989, p.5).

The recent Provincial budget, which trimmed approximately three million dollars from SCN's operating funds, has resulted in a freeze on development of the data network for the time being. A study of computer networking jointly funded by SCN and the University of Saskatchewan is nearing completion. The objective of this study is to assure that SCN's data network conforms to state-of-the art networking technology and protocol.



IN 1989-90 75% OF SCN PROGRAMMING WILL ORIGINATE IN AND BE UPLINKED FROM THE UNIVERSITY OF SASKATCHEWAN

20% OF PROGRAMMING WILL ORIGINATE IN REGINA AND WILL BE BACKHAULED TO THE UNIVERSITY OF SASKATCHEWAN

PRINCE ALBERT AND MOOSE JAW WILL SHARE THE REMAINING 5% OF PROGRAMMING

Figure 10
SCN BACKHAUL NETWORK

Conclusion

SCN has been received enthusiastically by the residents of Saskatchewan. The people generally accept that a need exists for increased access to information if they are to compete with the rest of the world. The reality of a sparse population and vast distances punctuated the need for effective communications 100 years ago when the province embarked upon development of a sophisticated telephone system for the time; this telephone network has been maintained as world class and the residents have maintained their desire for linkage. All echelons of endeavour in the province wish to enter the 1990s party to a communications network capable of connecting them to each other and to the world. This has been evident since the early 80s. Review of the development of the Saskatchewan Communications Network reveals that the leading thinkers of the time had a very clear concept of the need for and the configuration of a information system suitable to accommodate the special characteristics of the Saskatchewan people in regard to their education, industry, business, health, and culture. Contemplating the score card it appears that to this point SCN has "responded to six of ten recommendations underlying its creation" (Brown, 1990, p.548-556). This is by no means a bad score considering SCN is only in its fifteenth month of operation, and neither the Legislation nor the representative board of directors is firmly in place. It is unfair to be excessively judgmental at this juncture.

In spite of the long period between the recommendations of the white paper and the inauguration of SCN, distance education continued to develop in the province. Due to the pioneering efforts of the Saskatchewan Tele-Learning Association in development of an interactive full-motion satellite television delivery system, SCN has been able to immediately begin delivering credit and non-credit programming. Programming of the University of Saskatchewan's credit courses by satellite and the University of Regina's credit courses by fibre optics has continued under SCN. Development of additional uplinks, extension of the SCN Centres, development of the Narrowcast Network and addition of computer services appear to have enhanced the award winning STELLA concept. Effective

September 1989 SCN began to absorb satellite and other related fees for non-profit organizations. Program costs remain the responsibility of the program organizations. Program producers will contract directly with Saskatchewan's film and video industry. SCN has initiated a policy of "seed" or "motivational" funds to conduct initial planning or feasibility initiatives. These grants are in the order of $5,000 depending on the circumstances of the prospective production.

SCN has already had a direct impact on business and industry, with one company initiating manufacture of commercial quality satellite dishes and other companies experimenting with satellite uplinking systems. Technical support of the Narrowcast Network is being carried out by local Saskatchewan companies. The Saskatchewan Motion Picture Industry Association (SMPIA) has been closely associated with early development work initiated by SCN. Many SMPIA members have initiated productions for the network and others are tooling up to take advantage of the production vacuum created for Saskatchewan based programming.

The eyes of Saskatchewan and many others who are external to provincial boundaries will be focused on SCN over the next few months. The concept of a "shared use" communications network has demonstrated a high degree of potential for serving the distance education needs of Saskatchewan. The front-end work has been done well, cautiously, and deliberately, as is characteristic of Saskatchewan people. Now it remains to be seen how quickly and efficiently the small core of dedicated individuals who make up the initial complement of SCN management can bring the information services on stream. This will be no small task in light of the consideration that must be accorded the politics of the situation, the funding, the economy and the diverse expectations held for the Saskatchewan Communications Network. The outcome will be watched with great interest.

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TWO RESEARCH PARADIGMS FOR USE WITH VIDEODISC-BASED STIMULUS MATERIAL IN RESEARCH ON INTERACTIVITY AND MEDIA EFFECTIVENESS

Charles R. Dills,
and
Dr. Barbara Grabowski,

Videodiscs are hardware, not software, and are either further away from being courseware. Nevertheless they are often treated and discussed as if they are instruction, not the carrier of instruction. As Marshall McLuhan probably would have said, the medium has become the message.

This particular combination of medium and message has special significance for research in learning and instructional theory building, for research in instructional design models, and for media comparisons research.

VIDEODISCS IN RESEARCH

Videodiscs have four characteristics that are valuable to the researcher. First, the contents are permanent, and so are repeatable. Second, the order and sequence of the frames can be changed with each repetition. Third, videodiscs can be integrated with many types of delivery technologies and teaching models. Fourth, the videodisc, as well as the whole delivery system it is integrated with, can be transferred from investigator to investigator for use in replications of an experiment.

The researcher who takes advantage of these characteristics of the videodisc can avoid many of the problems that have beset instructional research in the past. Studies can be replicated in exact detail with new subjects. Reviewers would be able to examine the entire experiment to determine the nature of the instruction. When several experiments utilizing a particular instructional method fail, and when several others succeed at achieving the instructional goals, reviewers can examine the instruction

used in each experiment to determine the differences in the stimuli material.

This ability would lead to the generation of hypotheses concerning the cause of the differences in outcomes among the experiments. And, unlike pre-videodisc days, these hypotheses can be tested, since the materials needed to test them with are still available on videodisc.

The possibility of such examinations of stimulus materials makes possible the application of such statistical methods as meta-analysis to fine structural detail that has not occurred up to now.

Two examples of what can be done are provided by the media-comparison and instructional-methods comparison studies that used to be popular (Bovy, 1981; Clark, 1983; Clark and Snow, 1975; Fleming and Levie, 1978; Grabowski, 1988; Hannafin, 1985; Levie, 1987; Salomon and Gardner, 1984; Schramm, 1977; Shlechter, 1986; Torkelson, 1987). These types of studies often concluded that no significance could be found between the two methods being compared. Possible reasons given for the inconclusive results usually included several of relevance here.

It was often argued that more time and expertise were expended upon one treatment than on the other. The argument was also often given that there is no way to compare such studies with each other because no clear, detailed explanation was normally available concerning what happened during the treatment phases. It was often not even clear that two methods having the same name were even the same method, rather than two very different variations producing entirely different effects.

The argument was often made that differences between the two methods existed, but that outcome measures were not powerful enough to demonstrate this. (This argument is still often given in reviews of computer-based instruction vs. stand-up instruction.)

In reviewing these studies, Grabowski found that the questions asked were the wrong ones, the methodology flawed, and the results insignificant, along with one major problem being the lack of a unifying conceptual framework (Grabowski, 1988, p.33).

These studies can now be revisited. Exact duplication of these experiments is not possible, since no one, even the experimenters, even at the time they were occurring, knew what happened in

them. Also, broad comparison studies of the type generally performed (and still performed) with loosely-defined treatments, were generally ill-conceived. These experiments, as originally reported, are not recommended by anyone as possibly contributing to our store of knowledge or to practice.

However, with the videodisc, comparison studies can be designed which lack these faults, and which would possess the potential of contributing useful knowledge.

First, the same material can often be used in both treatments, since the sequence or the mode of presentation is usually what is being compared. Videodisc frames can be programmed in any order, and can be accessed by any number of devices for presentation. Video projectors and the new "Podium" program developed by IBM would allow the comparison of a videodisc-based stand-up instructional program with the same material presented in some other mode.

Further, by integrating computerized testing, interspersed questions and the automatic recording of key strokes, it is possible to measure effects as finely as is necessary. If any differences in outcome between two treatments exists, it can be ferreted out, providing the experimenter is a good enough thinker to ask the right questions. Data collection is no longer the problem. Even non-obtrusive measurement of fine detail is now possible.

Comparison studies of the type commonly done in the 50s and 60s have almost been stamped out, although occasionally they are still performed. Except for certain special functions, such as to show that a new media teaches well enough to deserve further study, we would not like to see these kinds of studies revived. However, there are at least two comparison paradigms that are worth pursuing, and both are best carried out using videodiscs.

TWO PARADIGMS

The first paradigm is designed to determine the effects of each component of a lesson. The lesson can be presented in two versions, with the only difference between them being the component

under study.

Grabowski (1988) believes that the disc is particularly useful in this paradigm. The stimulus material can all be conducted using the same material, but with the computer re-programmed in accordance with the requirements of the version of the components under study.

Further, the exact frame-by-frame, key press by key press, path of each subject through the lesson material can be recorded and analyzed. A variation on this paradigm then becomes possible. Instead of asking about the effect upon the short or long term retention rate when using different components (a behaviourist approach), questions can be asked about different processing paths students take under different conditions (a cognitive approach). Then, using exactly the same stimuli material from the disc, the two outcomes can be related (a holistic approach).

This paradigm has been followed in a number of studies, for example, in Ho, Savenye and Haas, 1986; Hannafin and Colamiaio, 1987; and gay, Trumbull and Smith, 1988.

The second paradigm is much less used, and probably not as well understood. This paradigm stems from those used in animal learning research and research on the operant analysis of human behavior. In this paradigm, a single subject is used in multiple trials, acts as his/her own control, and is compared to his/her own self under all of the various conditions being studied.

This paradigm is particulary useful for determining the interrelationships between instructional components, since all variables in the subject remain the same throughout the experiment. This paradigm can also be used to relate these components to cognitive styles and other personality variables in complex interrelationships.

One particular advantage of this paradigm is that, since each subject is run completely independently, and is analyzed initially as a single-subject, multiple-trial case, not all subjects in an experiment need to available at the same time. Providing that certain conditions are satisfied, or if the experiment is such that these conditions can for practical purposes be ignored, single subjects can be

run when they are available, and analyzed initially as single-subject experiments. Then, when enough such experiments have been accumulated, they can be pooled and re-analyzed as groups.

One condition to be met is that historical effects do not occur, causing some of the subjects to be effected in ways that the rest are not. A second condition is that when subjects are combined into groups, the subjects/trials must remain independent, and they must be combined using random distributions.

One study using this paradigm is being conducted at Syracuse University by Dills, Grabowski and Kerr. In this experiment, the interactions between Educational Cognitive Style of the subject and the style in which the stimulus materials are written are being explored using an interactive videodisc supporting a CBI program.

Other studies are planned using this same disc and computer program, slightly modified. These studies include work with advance organizers, accelerated learning and additional personality variables.

Analysis of these experiments will use, in the group phase, the profile matching software presented to the AMTEC convention in Saskatchewan a few years ago (Dills and Keppler, 1987), as well as more conventional methods such as regression analysis.

The single-case studies will be analyzed using the celeration line and the method of the split halves.

CONCLUSIONS

We are firm believers in the value of the videodisc as an aid to research, especially when combined with CBI. This belief is especially strong when the research question involves interactivity.

Two paradigms have been described which we believe make maximal usage of the advantages inherent in the videodisc. One of these paradigms is best suited for examining media and method comparison studies. Further, these types of studies can be refined into useful studies comparing the

effects of components of instruction and variations of these components.

The second paradigm seems best suited to study the effects of cognitive style, personality and other external (to the instructional sequence or mix of instructional components) variables on instructional components. This paradigm is also suited to studies in which few subjects are available at any one time, which would reduce the study to a pilot study using other paradigms. Use of this paradigm in this manner is limited by underlying assumptions to specific conditions, but these conditions often exist within the contexts being studied in learning from media.

The authors argue that these paradigms in consortium with interactive videodisc technology should be used in educational technology research much more often than they are. We believe that this would result in a higher quality of research, and would result in studies exhibiting much more sensitivity to the effects of different versions of the components of instruction, than is the case with most currently available studies.

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SOFTWARE PROGRAMS THAT PROMOTE MULTIMEDIA APPROACHES IN THE CLASSROOM

Presented by Bruce Elliott

Traditionally, students are perceived as passive beings who sit quietly at their desks performing the tasks assigned by the teacher. The teacher, cast in the role of fountain of knowledge, transmits the information that an outside body, such as a Department of Education, has decided is the "curriculum". Whether or not the "curriculum" is relevant to the students' lives at that particular time is less important than the need to "cover" it. Also, the knowledge to be transmitted is broken up into separate disciplines and the school day is divided into arbitrary time slots for each of the disciplines. Thus students' learning is fragmented and they often see little if any relationship between the fragments of knowledge that they are expected to assimilate.

This traditional role of the school and the teacher is being challenged by a new model of education, in which students play a much more active role. Active learning, activity based learning, child centred learning and a whole language approach are some of the names given to this new model of education. In the new model teachers become facilitators for student learning rather than transmitters of knowledge. They are effective compassionate professionals, who model learning strategies for the students in their classes.

Ken Goodman, Co-Director of the Program in Languages and Literacy at the University of Arizona, states that these teachers "guide, support, monitor, encourage and facilitate learning, but do not control it". [1]

In fact, administrators must in the words of Dr. Seymour Papert, "take teachers much more seriously as thinkers and activists, as people with a responsibility in society for change and not for implementation of ready-designed systems". [2]

Children are recognized and respected as learners who bring to school with them a variety of learning styles, a wide range of experience and back ground knowledge on which teachers can build

a successful program. The programs themselves are relevant to the needs and desires of the students because the students help to decide what is to be learned, the method by which it will be learned and the materials that will be used. The students in Ken Goodman's words "own the process" and the lessons are more than just school work, they are a part of the students' daily lives that reflect and help to interpret the world around them. One other key is the integration of language arts and content areas since reading, writing, speaking and listening must and do occur while studying other areas of the curriculum. Goodman explains the integration in these terms:

"Children speak, listen, write or read as they need to. If a puppet show is developed to dramatize a Lloyd Alexander story, then the story will be read, an outline or script will be written, and various class members will participate as actors, stage hands or audience. If mice are studied, groups may discuss and plan their study, resource materials may be read, posters planned and written, observations made and recorded, written and oral reports made. Manipulatives in math may be used to explore fractions, findings discussed and conclusions written up." [3]

Students frequently become highly motivated whole learners in an environment to which they can be fully committed, because they have helped to create, define and preserve that environment.

But, why is the traditional view of education being so severely challenged, and why is the new model gaining so much strength? The concurrence of several factors has produced the change. The perception that the education system was and is failing to properly "teach" reading and writing, and was and is producing too many "functionally illiterate" members of society focused more of society's attention on what was happening in schools. Simultaneously, new research done by psychologists and educational researchers such as M.A.K. Halliday, Marie Clay, Don Holdaway, Frank Smith, Kenneth and Yetta Goodman and many others pointed toward a different approach to language learning and teaching. The research demonstrated that language learning, whether oral or written, is striving for meaning and meaningful self expression. Both reading and writing, like speaking, are a dynamic process in which the person engaged is actively involved. The learner is an active recreator of

knowledge, not a passive recipient.

At the same time concern continues to grow about the number of students who choose to drop out of school rather than complete their education. The drop out rate seems to validate the concern that schools are not preparing students for life in a new, very different society that may evolve in the next century, mainly as a result of the rapid growth of new technology. Fred D'Ignazio, head of Multi Media Classrooms Inc. of East Lansing, Michigan, explains:

"What the workplace won't resemble is passive bodies sitting there while the boss tells them what to do, how to do it and then watches them while they do it. Since you're going to have to be proactive in your work life, why not start out as a proactive learner in school?" [4]

How does all this relate to multimedia in the classroom? Actually, the effective use of technology and multimedia provides a means to attack such major problems as motivation, the drop-out rate and preparation for life on the job. As Kathy Wilson of Bank Street states:

"One of the major difficulties teachers face is motivating their students. And that's the first thing that must be done if learning is to occur. Unquestionably, multimedia motivates kids -- even the learner-phobic." [5]

Also, as Fred D'Ignaazio states, "Multimedia is an ideal facilitator of proactive learning." [6]

Finally, Mr. J. Dezel, Vice-President of I.B.M., claims the effective use of technology is the primary reason why the drop out rate in Orangeburg South Carolina dropped from 34% to 4% over a four year period. [7]

What is multimedia? Multimedia can mean many different things. A slide presentation with narration played on a cassette player, preceded or followed by an outline or summation of the presentation using an overhead projector does provide a multimedia lesson. However, today "multimedia refers to (or can refer to) nothing less than the integration of text, audio, graphics, still image and moving picture into a single, computer-controlled, multimedia product." [8]

This high-tech approach to multimedia requires powerful computers such as Apple Macintosh

or I.B.M. P.S.2, etc., combined with CD.ROM, video disk, music synthesizers, optical scanners -- all controlled through powerful developmental software such as Hypercard from Apple or Linkway from I.B.M. However, there is also a low-tech approach that is supported by Scholastic Software, which has produced programs such as SuperPrint II, Stuper Story Tree, Slide Shop and Hyperscreen, that push the Apple II technology to the limit of its flexibility and power.

The use of low-tech multimedia in the classroom is the area that will be discussed, because it is the area supported by Scholastic software. Also, it is more readily available to the majority of schools and classroom teachers. Much of the hardware required to establish a low-tech multimedia centre is already in most schools. A basic centre would include a microcomputer, a video cassette recorder, an audio cassette player and a television. A camcorder should be the next component added. Later, as the money to purchase them becomes available and teachers and students become more comfortable using multimedia, an inexpensive scanner such as Thunder Scan and circuit boards, such as Computer Eyes and the Apple II Video Overlay Card can be added. About this time, a still camera and an inexpensive keyboard can also be added. This multimedia centre may be situated in one central location, or by use of audio-visual rolling carts, the centre can become mobile and move from classroom to classroom.

Once the multimedia centre has been assembled, how will it be used? Fred D'Ignazio has described the five main areas of multimedia publishing as: [10]

1. Desk Top Publishing - Print
2. Electronic Slide Shows
3. Audio Publishing
4. Video Publishing
5. Hypermedia Publishing

In desktop publishing students would use a microcomputer to write, revise, illustrate, and print a document. For example, students could use SuperPrint II to create a banner welcoming parents to

an open house or a sign announcing a fund-raising event. Big books can be written and added to the classroom library. Children can even create iron-on transfers, which they can use to decorate T-shirts, etc.

An electronic slide show is basically an automated or self-running presentation on disk that does not require a computer program disk for use. These slide shows may be transferred to videotape for wider circulation. The actual transfer is not that difficult with an Apple II. Simply disconnect the monitor cord from the monitor and attach it to the video-in jack on the video cassette recorder. If there is no television available, the VCR can be connected to the monitor. Then place the slide show disk in the drive and run the show. If an MSDOS system is being used an expansion board is needed to change the RGB signal to a standard American video signal NTSC. There are many different boards available. If the slide show contains sound, then the transfer is more complicated. A microphone may have to be attached to the VCR and placed next to the computer speaker. Although the Apple IIGS does have a headphone jack, it is high-level output, while the VCR is probably low-level input. The easiest solution is to turn down the sound on the IIGS, but if the sound is still distorted it may be necessary to purchase an adapter or microphone mixer to convert the high-level signal to a low-level signal.

The slide show may be an original story, a social studies essay or a scientific report. It will probably be a combination of text and graphics. The graphics may be clip art, original drawings, scanned images or a combination. Special effects may be added to enhance the transition from slide to slide or screen to screen. These slide shows can be created using Slide Shop and Super Story Tree from Scholastic.

In audio publishing the students may in effect create a radio show. They may use a word processor such as Bank Street Writer 111 to write their script. The keyboard could be used to add music, and sound effects may be added from Slide Shop. The students then record the presentation of their script with synchronized music and sound effects on audio cassette.

In video publishing the students will perform many of the same tasks as in audio publishing.

In fact if they simply recorded their radio show on videotape it would be video publishing. However, the students would probably want to use a program such as Slide Shop to add a title and credit screens.

Hypermedia publishing is used to create non-linear branching presentations that are controlled by the user. Users create their own pathways through the presentation, which should be a combination of several different types of media. Hypermedia is the most high-tech and the most sophisticated of the five types of multimedia publishing. It usually requires CD-ROM, video disk drives and a powerful computer, although the just-released Hyperscreen from Scholastic can be used to create hypermedia with an Apple 11E with only 128K of memory.

Once a teacher has decided to try a multimedia approach and the multimedia centre has been created, there are some basic approaches or strategies which can be used to integrate multimedia into the daily routine. Some teachers are more comfortable when students are required to sign a contract that outlines their responsibilities and duties before they are allowed to use the centres. Terms of the contract may require students to listen to the teacher, agree to help classmates, finish other unrelated assignments and take responsibility for care of the equipment. This permission to use multimedia as a reward for proper behaviour can produce a lessening of discipline problems and an increase in co-operative learning in some classrooms. One other benefit has been the increased responsibility for their own learning demonstrated by the students involved. In a child centred classroom the contract usually is not necessary, as the students already take responsibility for the maintenance of their learning materials, help to determine what and when materials will be used, and are experienced in co-operative learning. In either instance, the addition of the multimedia centre will be an exciting event and the students will require time to experiment with the equipment before production schedules are established. Once again, either the teacher or the teacher and students together may decide on which topics are to be chosen for multimedia treatment. The type of presentation and the scheduling of time for the production of the presentation may also be a co-operative decision.

Once the decisions have been made, even though some of these decisions may have to be changed later, production can begin. The level of sophistication will depend as much on the confidence level and willingness to take risks of the teacher and students as on their actual abilities, although the age level of the students will be an important factor.

Following the example of integration cited earlier, a primary class has just completed a story about one of their favourite characters, a big red dog named Clifford. Let us assume they have just finished reading "Clifford Takes a Trip" by Norman Bridwell and the decision to dramatize the story by producing a puppet play has been made. The students will either organize themselves or be organized by the teacher into groups to perform the various required tasks. One group may be the writers, who will create the script using either pen and paper or an easy-to-use word processor such as Bank Street Writer 111. There may be two production groups, one to create the puppet theatre and the other to create the puppets. The students creating the theatre may use the Super Print 11 poster format to create the background for the theatre, or to decorate the theatre. The students creating the puppets may use the clip art of Clifford found in SuperPrint Graphics Activity Pack IV Clifford, as a basis for their puppets. They simply select the clip art they want, print it, cut it out and paste it onto a stick or make finger puppets. Of course, should they wish, both groups can use the paint program to either modify the clip art or to create original characters. A fourth group may use the sign function of SuperPrint 11 to create announcements and to send invitations to other classes to attend the performance of the puppet theatre. It may be wise to allow all students to have the opportunity to be the performers. Perhaps the teacher or an older student could use the school's video camera to get a permanent record of both the progress of the students as they go about their tasks and the performance before a live audience.

If a grade six or seven class has been reading a book such as "The Secret of Nimh" by O'Brien, both social studies and science projects can be incorporated into an integrated study using multimedia. A simple low-tech approach would be to use Super Story Tree to create a report on rats that could be

presented as either a desk top published report or as an interactive electronic slide show or both. As a first step the students may organize themselves into groups and then decide the topic that each group would research and "write". The group would then create a master story chart or map of the report. For example, the report might be organized around such topics as: Species of Rats and Their Range; Rat Habitat; Rat Anatomy, Life Cycle, Food and Predators. A separate map would then be created for each topic to outline the points that would appear on each screen. Once the total map has been finished, then the creation of the electronic slide show can begin.

By selecting one of the title screens provided in the graphic background library, and an appropriate font from the fonts library, a very professional looking title screen can be created. Adding a page effect, such as wipe left or right, will heighten interest in the presentation. The continue link, which is the "normal" way of reading from page 1 to page 2, will be used to send the reader to the first page of the report, which may appear something like this:

Rats have been loathed by humans for centuries. Despite people's efforts to eradicate them, rats remain plentiful. This report will study:

1. Species of Rats and Their Range
2. Rat Habitat
3. Rat Anatomy
4. Life Cycle
5. Food and Predators

Please choose the topic you wish to read first by pressing the appropriate number.

The creators of this report will have selected the choice link and the reader, having made the selection, will proceed to the appropriate page. When the reader finishes the chosen topic there will be another choice link, and once again the reader will select one of the remaining topics to be read. Of course at the end of each topic there will also be a quit option, which will allow the reader to exit. If this report is presented in printed form, the first option listing will include appropriate page numbers,

so the reader can proceed directly to the selected topic.

Another possibility is that the students will be assigned or will decide to create their own adventure story. The students may decide to write a story that has as many different versions as they are capable of sustaining. In this approach the students will create a "double branching" story map. Double branching simply means that each page will provide the reader with two choices, each of which will lead to a different version of the story with a different ending. Once the authors of the story have reached the number of versions they want, they may then either use the continue link to go directly from page to page to the end, or they may add in more choices but use a continue link to pull the reader back to the main story line. There is also one other option available to the authors. They may use some chance links, where the computer decides on the basis of a mathematical ratio how often the reader will be presented page A or page B. For example, the authors might decide to use a 60-40 ratio so that the reader would be presented page A 60% of the time and page B 40% of the time.

Neither the scientific report on rats nor the adventure story will be text only. The authors will also be illustrators and create graphics pages, or they may combine graphics and text on one page. For example, in the topic "Food and Predators" rather than just listing the predators of rats the illustrators may use clip art, original drawings, or if they have Thunder Scan or another simple scanner available, they may add pictures of the predators taken from books in the library. Of course they must be careful to give credit for any copyrighted material used, and to use only short excerpts.

As another approach to the report on rats, another group of students may want to create a videotape presentation. This group would need either the opportunity to use the video camera to record rat behaviour or the opportunity to take closeup photos of rats. Then using the video camera as an editing VCR, they can select and edit segments for use in the presentation. If they have available a circuit board such as Computer Eyes or the Apple 11 Video Overlay Card and Thunder Scan, they can produce a very professional looking tape. They could, for example, use Computer Eyes to capture and digitize a close up of a rat from the video, or use Thunder Scan to digitize a photo and then use

Slide Shop to store the picture for future use. The captured picture might become the title screen or a background to which text and computer-generated graphics are added. They could also use the "captured" picture of the rat as the background on which they would show clips of the video using the Apple 11 Video Overlay Card, while text or computer graphics could be added on the remainder of the screen. These full motion clips can be mixed with text slides created on Slide Shop to give information, or the students can write a script for the video and then record their narration direction onto the videotape. They could also add special effects between screens. The authors will develop their video editing abilities as they experiment with different sequences and approaches to the combination of slides, full motion video and narration.

The newest multimedia program from Scholastic – Hyperscreer – will allow the students to create a hypermedia report. If the students were to use the same topics outlined earlier with Super Story Tree, the first or home screen of the stack would be the title screen. It would have a link to screen button that would take the reader to the topics screens. Each topic would have a separate link to screen button from which the reader would make a selection. Then single screen links would lead the reader through that particular branch to the last screen. Here another series of screen links would allow entry to the other branches, or selection of a link to stack button would return the reader to the home screen.

The methods of presentation of information on the screens may be varied and creative. On some screens there may be only graphics, but the option of selecting a pop-up text button may be provided. If the button is selected a window in the middle of the screen, with the textual information that the author has provided, will appear. This pop-up text button can also be used with text screens to add extra background information or even as a link to another screen with more detailed information, which is provided only for those who wish to explore the topic in more detail. There may be a sound/fx button, which if selected would add dramatic sound effects or music, or even digitized speech to the screen. Perhaps a multi-button has been provided, which when selected by the reader automatically

operates the pop-up text button, then the sound/fx button and even a link to screen button that leads the reader to a new screen.

Perhaps the feature that more than any other brings Hyperscreen into the world of high-tech multimedia is the video control button. This button controls a Pioneer LD-V4200 video disc player, and allows for the creation of advanced command boxes. The author may design the advanced command boxes so that selection of the video control button will, on one screen, turn off the computer graphics, display a series of still pictures stored on the disc for a specific length of time, turn off the disc player and turn on the computer graphics. On another screen, it may turn off the computer graphics and display on the screen a preselected segment of full motion video, maybe even repeating the segment at half speed, then turn off the disc player and return to the computer screen. If the Apple Video Overlay Card is in the computer, both Hyperscreen graphics and video can be displayed simultaneously.

Therefore, using Hyperscreen the students would be able to create a report containing still pictures, full motion video, digitized speech, sound effects, computer graphics and text. The reader would be able to browse through the report, select the order in which the topics would be read, and if the authors have provided a text entry button, respond directly on screen.

These examples of how Scholastic programs support multi-media in the classroom are all based on approaches and activities outlined in the teaching and references guides which are included in the teacher editions of the programs. These guides, as well as the Scholastic Guide to Multimedia, also provide technical suggestions for various methods of interconnecting and operating the components of the multimedia publishing centre.

Will the use of multimedia in the classroom promote the goals and characteristics of the Third Educational Technology? Will it encourage a holistic, process-oriented approach? Will it develop integration, interactivity, collaboration and student organizational and management abilities? The answer to all of these questions is a qualified, "Yes it will".

Multimedia can be both an impetus to move more teachers towards these approaches and a

support for teachers who are already using a holistic, process-oriented approach. Teachers who feel more comfortable when they are in 'control' and use multimedia, will discover their role being changed by the very nature of multimedia. If students are to produce a multimedia report, they must learn to collaborate, both because of the amount of time and effort required to produce a multimedia report and because they will have to work in groups as there will be only a limited number of multimedia centres available. While the teacher may still assign projects, the students must take responsibility for both the maintenance of the equipment and the actual use of the equipment. This assumption of responsibility, combined with the necessity for collaboration, will result in a less teacher oriented approach.

A difficulty that may limit the use of multimedia is the amount of time required for the students to research, write and produce their presentations. However, the approach will have such a positive motivational impact that both teachers and students will want to continue using it despite the problem of finding enough time to use it properly. Therefore, there will have to be more cross curricular integration, so that the time allocated for one project will address more than one discipline. The multimedia science projects described above require the development and practice of reading and research skills to discover the information and writing skills to create the script. Also, the actual production of the report will involve the students in aspects of the creative arts. As well, co-operative problem-solving skills will be needed to overcome the diversity of opinion about how the project should be approached, edited and completed, while making certain that everyone involved contributes. Finally, the students will need to develop managerial skills to guarantee that the report will be completed on time. Thus language arts, social studies, science and perhaps art have been integrated in one collaborative, process-oriented project.

FOOTNOTES

1 Ken Goodman, What's Whole in Whole Language, p. 29

2 Louise C. Orlando, "The Lessons of Logo", Teaching & Computers, p. 22

3 Goodman, p. 30

4 Robert McCarthy, "Multimedia", Electronic Learning, p. 30

5 McCarthy, p. 30

6 McCarthy, p. 30

7 "An Interview with IBM", Classroom Computer Learning, p. 20

8 McCarthy, p. 26

9 Fred D'Ignazio, The Scholastic Guide to Multimedia, p. 7

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VIDEO - A RESOURCE FOR THE 90S
SUGGESTIONS FOR DELIVERY AND INTEGRATION

John Godfreyson

Introduction

There is little doubt that the use of video has a significant role to play in education. These media resources are being selected and prescribed as the means for delivery of some aspects of the curriculum. There is widespread recognition that non-print resources when properly selected and when used in a systematic and planned way are vital tot he way in which learning takes place.

The full report includes a literature review as well as an analysis of the data provided in surveys done by a number of other agencies. The following is a brief overview of the survey conducted for the Ministry of Education in British Columbia.

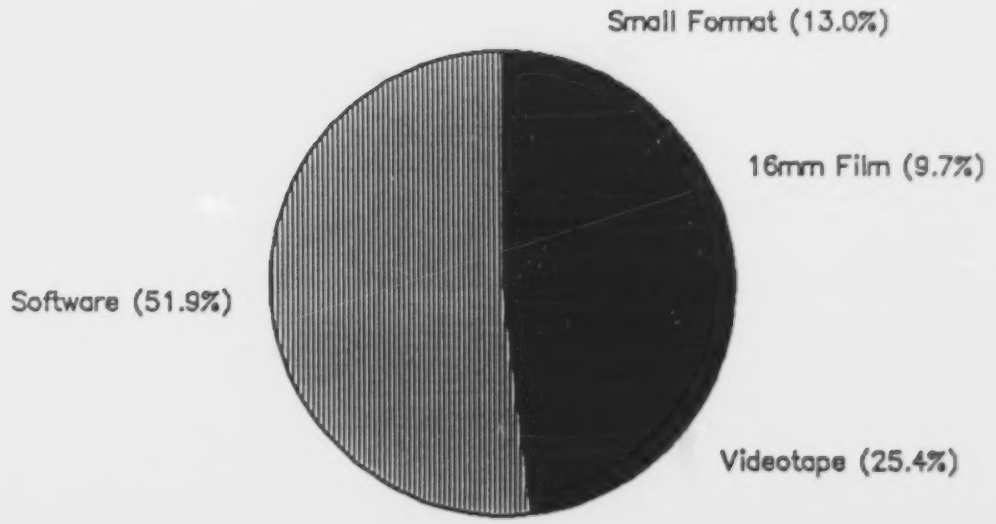
Approximately 1600 provincial surveys were distributed by PEMC in November, 1989. A total of 817 surveys were returned by the end of December. This indicates a return rate of 51%. The survey distribution included the full distribution of surveys to all teachers in 4 school districts. These districts were selected on the basis of both size and geographic location in order to reflect a provincial profile. A total of 309 surveys were returned.

Current Media Usage

Respondents were questioned regarding their use of a variety of media formats.

Computer implementation has been a major issue in British Columbia. It is therefore not surprising that this particular media form received a very high response. It is significant to note the relative positions of the other media. The use of 16mm film trails significantly behind the use of either videotape or small format material. This is likely a major shift which has taken place in the last 5 years.

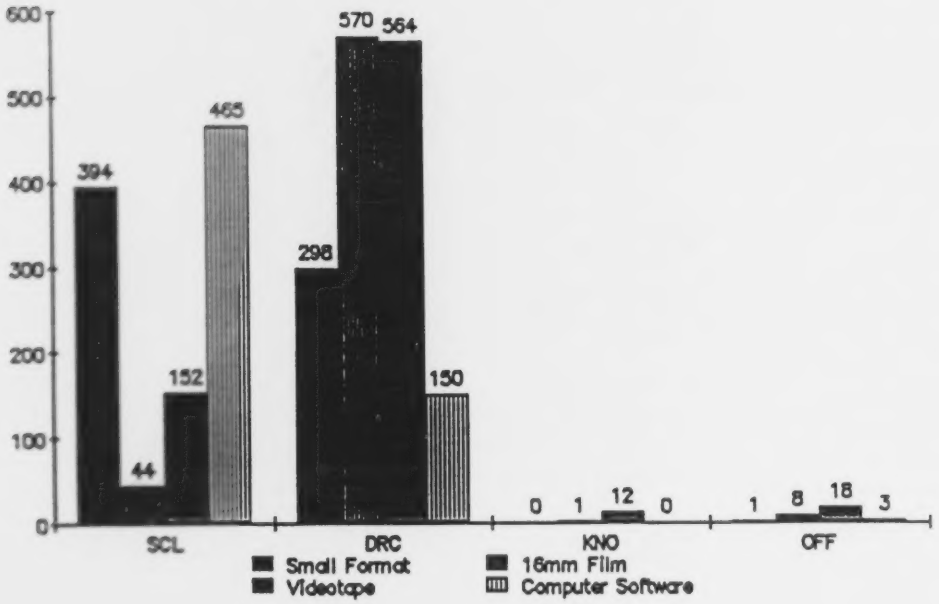
Chart 1: Current Media Use
(Provincial Survey - Respondents = 705)



Sources of Media Materials

The way in which the material is accessed by teachers has also changed. Several years ago, some school districts discouraged the purchasing of media materials at the school level. The survey responses indicate a definite shift away from this type of direction. Respondents were asked to indicate primary sources for a variety of media materials.

Chart 2: Primary Media Sources
(Provincial Surveys - Respondents = 763)



SCL	District Resource Centre
DRC	District Resource Centre
KNO	Knowledge Network
OFF	Off-Air Recording

It is significant to note the emphasis on computer software and small format materials at the school level. There is also evidence to suggest that the schools are beginning to develop school-based video collections. District resource centres are seen as the primary suppliers of 16mm film and videotape. The Knowledge Network and other Off-air sources seem to play a relatively minor role as primary sources of video materials.

Factors Affecting Media Use

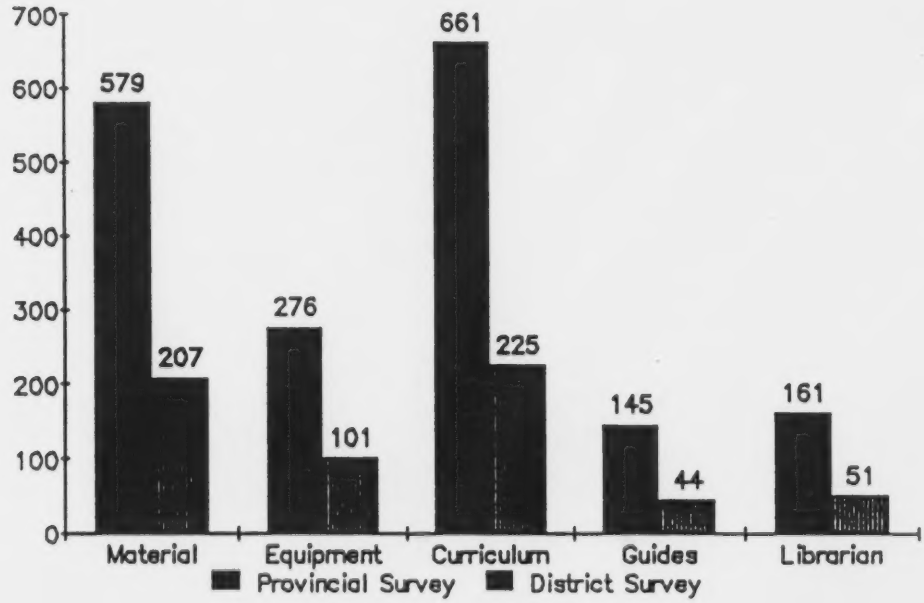
Respondents were asked to rank on a five point scale (1 - High, 5 - Low) which factors had the

most significant effect upon their use of media in the classroom. The following categories were provided:

1. Availability of Media Material
2. Availability of Equipment
3. Curriculum Relevance
4. Availability of Support Material (Teacher Guides)
5. Assistance from librarian in locating material.

The following chart was prepared using the total of the number "1" and "2" responses in each category. Some respondents assigned equal weights to some items. Therefore the total number of responses tends to be higher than expected.

Chart 3: Factors Affecting Media Use
(Provincial & District Surveys)



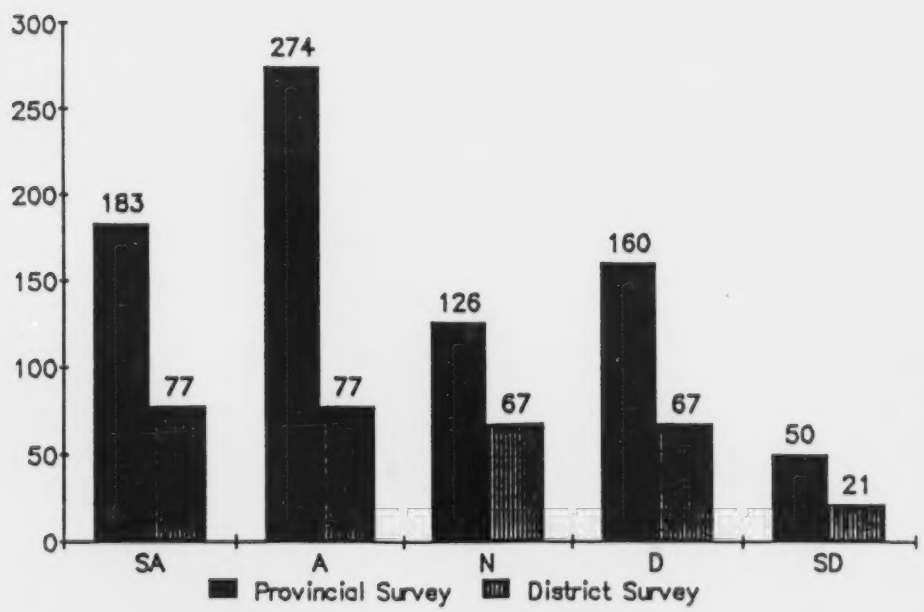
The fact that curriculum relevance received the highest emphasis is consistent with the findings in the literature review. Educators are primarily concerned with how well the material fits into the classroom program. The availability of media material is obviously another significant issue. Learning is a process which requires access to materials at the appropriate time. Scheduling materials from outside sources can be a significant problem. Equipment availability was in some locations a factor affecting the use of the media. There was considerable consistency between the provincial and district surveys.

Future Directions

The survey asked a number of questions which were intended to gather opinions regarding what might be seen as practices and trends in the schools of B.C. The following are the responses to selected questions.

> It would be preferable for every school building to have a videocassette collection right in the building rather than order from a centralized collection.

Chart 4: School Based Collections
(Provincial and District Surveys)

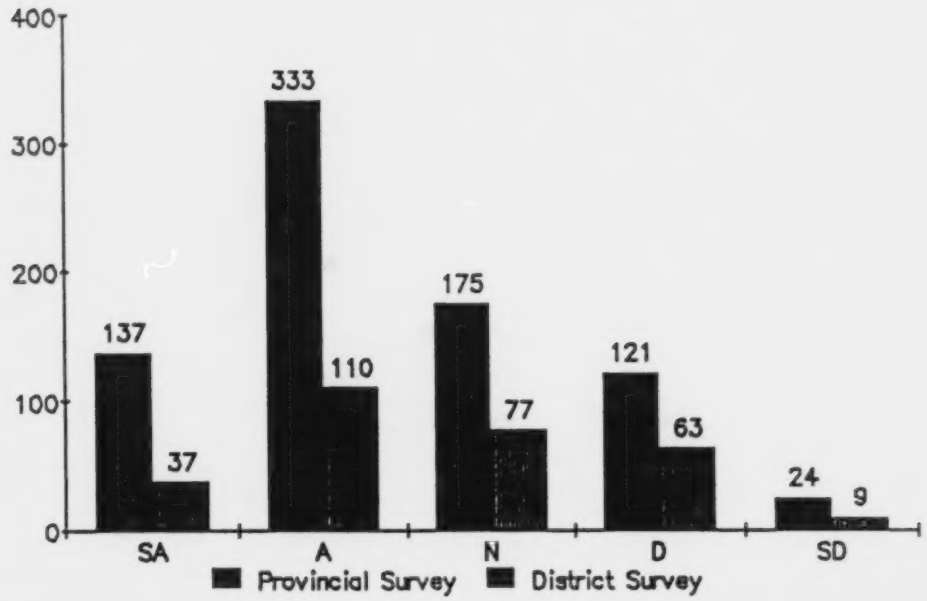


There was clear support for the development of school-based collections. The SA/A responses were twice the D/SD responses. Many respondents commented that both the school and district collections were needed.

The difference between the provincial and district surveys is marked. This could possibly be explained by the comments received from the respondents in the smaller districts. They indicated strong support and in some cases a protective feeling towards the district based model. It might be concluded that based on current media use it is possible in smaller districts to provide the needed services from a central facility.

> Students should have access to the videotapes in the same manner as books.

Chart 5: Student Access
(Provincial and District Surveys)



The response to this question was particulary interesting. The pattern of responses was similar to question "A" which dealt with school-based collections. However, there was a heavier weighting towards the Neutral (N) and Agree (A) categories.

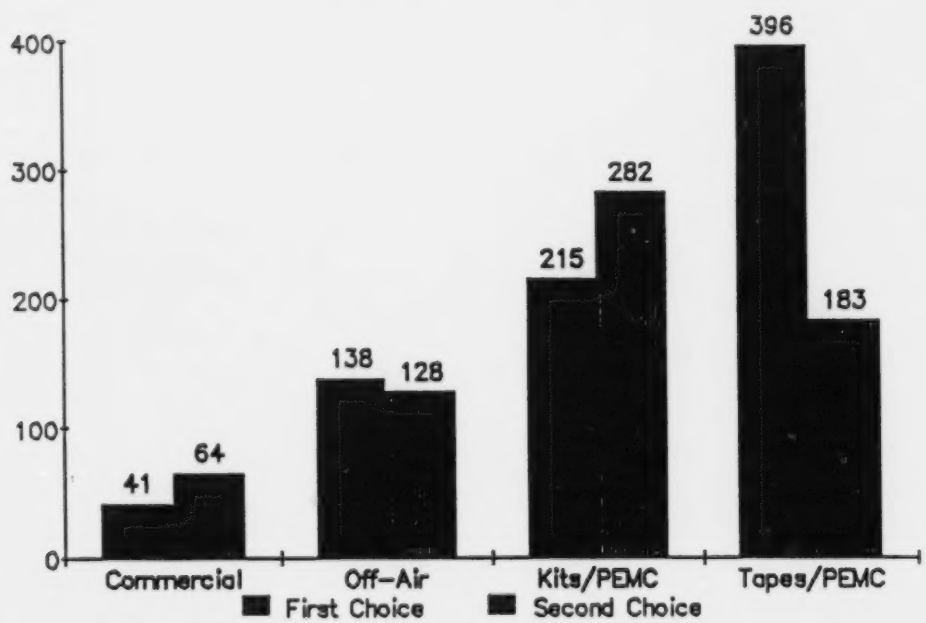
What is significant is that 118 of the respondents who either Disagreed (D) or Strongly Disagreed (SD) with the establishment of school collections, also indicated that they Agreed (A) or Strongly Agreed (SA) with the concept of student access.

In addition, 69 of the respondents who either Agree (A) or Strongly Agree (SA) with the establishment of school collections, also indicated that they Disagreed (D) or Strongly Disagreed (SD) with the concept of student access.

There was no clear indication as to the reasons for these differing responses.

> Using the numbers from 1 (most preferred) to 4 (least preferred) indicate the manner in which teachers and schools would choose to acquire videotape programming for use in classrooms.

Chart 6: Video Source Preferences
(Provincial Survey - Respondents = 677)



This chart provides a summary of the "1" and "2" responses. There is clear support for the continued use of PEMC/Image Media as the suppliers of video programming in both "individual tape" and "kit" formats. Some respondents suggested that commercial suppliers tended to price their materials far

beyond that which current budgets could support. There were also concerns with the copyright implications of using Off-Air sources.

Survey Summary

The provincial responses were characterized by a higher ratio of administrators and librarians than individual teachers. The number of librarians exceeded by a slight margin the administrators.

Access to school and district resource centres/libraries seemed to be common throughout the province. There were only a few locations where access to district facilities was not possible.

The significant role of computers was well illustrated by the media use data. However, video plays a major role in the delivery of curriculum materials, surpassing both the use of small format and 16mm film.

School-based collections were the major source for small format materials and computer software. A number of locations also indicated that the school was also their primary source for videotape. The Knowledge Network and other Off-Air sources tended to be viewed more as a secondary source.

Respondents were particularly resourceful in obtaining materials from a number of sources. PEMC (Provincial Educational Media Centre) and the National Film Board were indicated as well used agencies. The PEMC reference in these instances referred to the 16mm loan collection.

The data seems to suggest that administrators and librarians are reasonably well aware of the services provided by PEMC/Image Media. However, individual teachers may be less knowledgeable in this area and there may be marketing/advertising opportunities for PEMC/Image Media through the use of teachers' professional groups.

Curriculum relevance and material availability proved to be the dominant factors affecting media use. Equipment availability was a somewhat less significant factor.

There was strong support for the development of school-based collections. Opinions, however,

were divided on this issue. There was a marked difference between the provincial and district surveys in this particular case.

Many respondents indicated concern with the question dealing with computers and videotape equipment. They felt that the use of the two media were distinct and attempting to compare the two was not appropriate. Nevertheless, almost 30% of the surveys showed a preference for having videotape equipment.

The availability of teachers' guides and cataloguing information received a very positive response. This was not particularly surprising since they are not controversial issues.

It was particularly interesting to note the strong support for student access to videotape materials. However, a comparison of the school-based collection data and the responses to this question posed some interesting questions which are detailed in the main report.

Respondents also recognized the need for teachers to receive more training in the use of the various technologies in providing learning opportunities.

There was strong support for the continued presence of PEMC/Image Media as suppliers of videotape programming. The preferred format was for individual videotapes. Curriculum based kits were a close second. The "First Choice" responses for PEMC outweighed the other suppliers by a ratio of more than 3:1.

The most frequent comment received dealt with the issue of funding for resources. Many of the respondents indicated agreement with the need for school-based collections. However, the source of the funding for these acquisitions was unknown since current funding levels did not allow for the purchase of these materials.

An analysis of three questions on the basis of respondent group revealed some interesting observations:

1. Secondary respondents perceived a greater need for video programming. This is perhaps a result of the fact that in some high school courses, videotapes are already the authorized resource.

2. Librarians and teachers were more in agreement with the establishment of school-based collections than were administrators.

3. Teachers were less comfortable with allowing student borrowing of video programming.

The results of this survey demonstrate the strong position which video programming has in the delivery of curriculum resource materials in the Province of British Columbia. The establishment of school-based collections will likely continue and strengthen. However, funding for these materials is an issue. Many respondents agreed with the concept of student access to these materials in the same manner as other more traditional curriculum resources. There is also strong support for the continued existence of PEMC/Image Media as the primary supplier of videotape materials in the educational setting.

POSTMODERN EDUCATIONAL TECHNOLOGY

Denis Hlynka

Abstract

Contemporary intellectual theory builds from at least three divergent sources. First, the Khunian analysis of scientific paradigms explains how alternative versions gain credibility. Second, postmodern and deconstructionalist views derived from contemporary literary theory and the critical theory of Jurgen Habermas show the inconsistencies within any given world view. Third, Eisner's (1979) curriculum evaluation model of criticism and connoisseurship provide a way of looking based on aesthetic sensibilities as opposed to scientific and positivistic models.

How does educational technology fit into the world of the postmodern? This presentation will provide a primer on the current trends in alternative paradigms concentrating on the implications for educational technology. How does educational technology convey knowledge? What happens when information is viewed through a post-modern lens?

Postmodernism is especially appropriate to the AMTEC 90 theme: "Create the Wave: the Third Educational Technology." It is no longer possible for educational technology to exist as support to first wave agricultural society or second wave industrial society. The third wave, the age of information, requires a postmodern sensibility in which reconceptualization and deconstruction, modernism and postmodernism all work harmoniously and synergistically together.

POSTMODERN EDUCATIONAL TECHNOLOGY

Introduction

I begin with a caveat. In exploring the potential contribution of the "postmodern condition" (Lyotard, 1988) to educational technology, I do not intend to lessen the value of other paradigms of analysis. This caveat seems to be an important one, especially in light of the breakout of what Gage (1989) has termed "the paradigm wars." He is referring to the unfortunate tendency which occurs when

one valorizes one paradigm over another. The broadest outlines of the debate are found in the qualitative/quantitative binary opposition, in which the spectator is expected to choose between the two. If the decades of the 1950s, 1960s, and 1970s were at a time in which the technical, scientific, quantitative paradigm held sway over the social sciences, then the 1980s seem to be a time in which the qualitative, sociological, participant-observation models have slowly moved into predominance.

The viewpoint expressed here is that all paradigms have value, that there is not just one way of seeing, or even two, but multiple ways. Indeed to advocate a postmodern approach to inquiry into educational technology is probably a plea for such co-existence of multiple views. But more on that later.

A second caveat is that educational technologists seem to be in the midst of clarifying or reconceptualizing their field (Mitchell, 1989; Beckman, 1988; Heinich, 1984). Seen in isolation, such activity might seem suspect. Seen within the broader context of education, one soon realizes that the current ferment in educational technology has already passed through curriculum theory and education in general. William Pinar's reconceptualists, Michael Apple's neo-marxists, and Cleo Cherryholmes' post structuralism are only three examples. We are not alone in our questioning. Indeed, one might argue that educational technology seems to be trailing in the examination of contemporary discourse-practices.

The purpose of this paper is to introduce the concepts of postmodernism into those discursive practices as they impact on educational technology. To do that, it is necessary to examine first the concept of postmodernism in its broader outline. Then we shall apply several postmodern strategies to educational technology.

The Beginnings

There is a new way of looking at the world; the word for it is postmodern. Where do we begin a discussion of this slippery but important concept. One way is to begin "Once upon a time...". "Once

upon a time" is particularly appropriate since it provides us immediately with the postmodern paradox. On the one hand we believe in progress derived from the power of science and technology. Mankind is future-oriented. But when we say "once upon a time..." we are remembering the past. More than remembering the past, we say it in reverential tones, which implies that things were better "in the good old days"..."once upon a time". Yet we can't have it both ways. Or can we? Were things better then? Or will things be better in the future? This paradox is in many ways the essence of the postmodern argument.

"In the beginning..." we believed that there were good guys and bad guys (and we were the good guys, of course). We believed that there were universal truths, (transcendental signifieds) and fixed meanings. We believed in the power of science and technology to lead us to a better life.

Yet, even in the beginning there were cracks in the mirror suggesting that all was not quite right in the positivist, scientific, empiricist theories. These cracks appeared across the disciplines, in physics, in architecture, in philosophy, in the social sciences, and in education. Postmodernism is living and working within those cracks, in the margins, and on the parergon.

Domains of Postmodernism

Unfortunately, the concept of postmodernism is not an easy one to grasp at first try. As has already been noted, the origins of postmodernism range over a variety of disciplines:

(a) physics: Newton gave us the structuralist, positivist model of the universe. Newton showed that our universe was a mechanical universe, obeying precise scientific laws and that it was only up to scientists to ask nature the right questions. The confidence we held in the positivistic model is reflected in Alexander Pope's famous lines:

> Nature and nature's laws lay hid in night:
> God said "Let Newton be"
> And all was light.

Yet is was only a matter of time before things began to go wrong. Mathematician Albert Einstein

showed that physical phenomena were in fact relative. Physicist Werner Heisenberg showed that even in physics uncertainty was the rule, that it was impossible to measure both the position and momentum of a particle. The breakup of the Cartesian universe in physics was to be paralleled by similar activity in the social sciences.

(b) architecture and art: Christopher Jencks is normally credited with first using the word "postmodern" referring to a "double coding" of architectural styles, resulting in irony in architectural design.

(c) philosophy: Jacques Derrida has coined the term **deconstruction** to refer to a philosophic way of thinking which tries to expose internal inconsistencies. In brief, deconstruction may be considered the methodology of postmodernism.

(d) social sciences: Michael Foucault has explored alternative ways of looking at power relationships that have influenced our concept of history.

(e) literary theory: Semiotics, the study of signs, has provided us with new ways of looking. Literary criticism has taken the lead, with such critics as Umberto Eco, Robert Scholes, David Lodge, and others. Ulmer (1985) provides a natural bridge between literary theory and educational technology in his analysis of post(e)-pedagogy, a pedagogy for an era of electronic media.

(f) education: Cleo Cherryholmes (1989) has provided a poststructuralist view of Tyler's rationale, Bloom's Taxonomy, and Schwab's "practical" based on Derrida and Foucault. His analyses can pave the way for postmodern commentary on educational technology.

(g) educational technology: Postmodern investigations within educational technology are still rare, but Hlynka and Belland (1990, in press) have collected some two dozen papers which reflect such a propensity within a broader domain of educational criticism.

What is Postmodernism?

Here are a handful of definitional writings to put the term into perspective.

Prigogine notes a movement "towards the multiple, the temporal, and the complex, away from the universal, the stable, and the simple."

Solomon (1988) writes that "the postmodern experience is best described as a perceptual montage...narrativeless flow and violent juxtapositions of discontinuous images...in the postmodern world, narrative has lost its sacred power. The postmodern myth has rejected the centering structures."

Jencks considers the postmodern to consist of a "double coding", or double meaning.

Eco adds the concept of irony to the list of descriptors:

> The moment comes when the avant guarde (the modern) can go no farther, because it has produced a metalanguage that speaks of its impossible texts. The postmodern reply to the modern consists of recognizing that the past, since it cannot really be destroyed, since its destruction leads to silence, must be revisited, but with irony.

Lyotard (1984) focuses on postmodernism as a "incredulity to metanarratives."

In short, we are living in a world which has come to recognize pluralism in place of a single transcendental reality. There is not one best way; there are many ways. The modern exists within a structural model searching for a singular best. The postmodern recognizes multiple realities.

Postmodernism and Educational Technology

Educational technologists are, above all, practical educators who need to know basic answers to critical practical questions. Questions like these probe the relation between theory and practice and need to be answered:

1. How does the postmodern view fit into the project of educational technology?
2. How will postmodern analyses help the teacher and the instructional designer?
3. What are the implications for instructional development?
4. Do we **design** educational media products differently for a postmodern audience? Or is there a difference in **utilization** techniques of instructional products and teaching materials?

5. Is there an algorithm with which one can deconstruct the products and processes of educational technology?

My answers to these and other questions are only tentative and at this stage open to further more detailed inquiry. One answer is to ignore the questions and argue instead that our first task is understanding. In the words of McCracken (1989), "We need multiple modes of communication for multiple ways of knowing (p. 20)." Postmodern, deconstructive, Foucauldian and critical analyses assist us in seeing the world differently. In broadest terms, postmodernism can provide: survival skills to live and teach and learn in today's world; multiple explanations of what is being valorized coupled with ways of reversing that valorization; and tools to respond critically.

Postmodern Simulation

Space permits only one extended example of postmodern analysis. I have selected one significant sub-domain within educational technology, namely the topic of simulations. Simulations may be simple or complex; they may be highly interactive or one way information presentors; and they may require simple to sophisticated hardware/software support. Simulations are appropriate in elementary and secondary classrooms to give students a better and closer look at a real world situation which otherwise might not be available. Simulations are also found in sophisticated adult training programs, the most noted example of which are flight simulators for the training of pilots.

Educational computer software programs use a variety of simulation techniques to re-create, for example, the Oregon Trail experience, the flight of an airplane, driver training experiences, and a host of other topics. Educational film and video programs which re-create history also provide a simulated experience. Films such as Riel, Hudson's Bay, and Anne of Green Gables present three filmic views of Canada which while they are not interactive, nevertheless, simulate dimensions of the historic experience so that we can experience another time and/or another place. Planetaria programs simulate the universe. IMAX films use super-large screens to put the audience as directly as possible into the

picture. Museums sometimes show reality, as in actual artifacts; but sometimes they simulate reality as does the Tyrell Dinosaur Museum in Drumheller, Alberta which focuses on recreating dinosaur artifacts, rather than displaying the far-too-delicate real things.

The word simulation itself is a subtle one, competing with simulator and simulacrum. Simulacrum refers to the image, the picture, the effigy; simulation refers to the process or act of simulating; and a simulator is the device that enables an operator to produce the simulacrum.

It is important that we have ways of looking at and analyzing how simulations work. Jean Baudrillard (1983) has provided a postmodern view of simulacra. He writes:

> These would be the successive phases of the image:
> - it is the reflection of a basic reality,
> - it masks and perverts a basic reality,
> - it masks the absence of a basic reality,
> - it bears no relation to any reality. It is its own pure simulation.

Baudrillard is concerned with identifying and exploring an inherent paradox as to how a simulacrum operates. His first level is obvious: the simulacrum reflects reality. Perhaps for most of us, that is where the analysis stops. But for Baudrillard this is only the beginning. Following a tactic reminiscent of McLuhan's (1988) statement of the laws of media, Baudrillard pushes the analysis of the simulacrum to the limit.

Let us consider two examples: television news, and the popular grade-school simulation already mentioned above, titled The Oregon Trail. The first will provide us an illustration within the popular culture realm; the second relates to classroom educational technology.

Consider first television news as a simulation of what is happening around the world. Baudrillard's first phase would note that television news is a reflection of reality; it shows what is really happening.

The second phase suggests that the simulacrum masks reality. How does television news mask reality? Simply by not reporting all stories, by being selective. Of course, one may not intentionally hide newsworthy events, but that is not the point. It is, says Baudrillard, the nature of the simulacrum

that some dimension of reality will inevitably be masked.

The third phase suggests that in fact there is no reality out there, and that television news hides that absence. That is, television news provides structure where there is none; it superimposes value judgments of vested interest on isolated events; it takes chaos and creates an artificial "reality" that isn't there.

The fourth phase moves to the ultimate conclusion: If television news masks a non-reality, then in fact, there is no reality. Or, television news is what is real. We try to make our reality fit based on what we have been shown on the news. TV reality comes first, then its simulacrum. Baudrillard calls it the "precession of simulacra." "The territory no longer precedes the map, nor survives it. Henceforth, it is the map that precedes the territory (quoted in Hlynka & Belland, 1990, p. 522)."

Our second example was the simulation-game called The Oregon Trail. The Oregon Trail is a well known title dealing with the problems encountered by the American settlers and pioneers on their way west. Streibel (1986) describes the program in some detail:

> It provides a simplified environment for elementary aged school children where they can make "decisions" and watch the "consequences" of their actions. Hence, forgetting to buy enough bullets inevitably leads to program termination. A student can "win" if he or she keeps a careful record of the "purchases" and analyzes the relationships between events, supplies and mileage.

At the first and basic level, we can readily agree that the simulation re-creates what it must have been like to travel the Oregon Trail. On the second level, we realize that some reality is hidden, masked, omitted, or just plain ignored. At the third level, we move to a consideration that the simulation masks a non-reality. Finally, at the fourth level, we are led to realize that there is no such reality as the simulation suggests. We are inventing a series of decisions and consequences that the pioneers of the Oregon Trail probably never experienced. We are inventing a new reality. And henceforth we will conceptualize the Oregon Trail in distorted twentieth century terms and twentieth century decisions.

Again Baudrillard:

> In the first case, the image is a good appearance - the representation

> is the order of sacrament. In the second, it is an evil appearance - of the order of malefice. In the third, it plays at being an appearance - it is of the order of sorcery. In the fourth, it is no longer in the order of appearance at all, but of simulation (Ibid, 528).

In this light, it is appropriate to note that dictionary definitions of simulation/simulacrum tend to focus not on the paradigmatic dimension, but on the negative connotations of misrepresentation, willful deception and sham. One begins to wonder why simulations rate so highly as an educational tool.

Finally we need to note that this kind of analysis, while it may seem theoretic and of minimal practical use to practitioners, is invaluable to assist us in keeping our perspective. It helps us see more fully the nature of the medium with which we are working.

Postmodernism and AMTEC 90: "Create the Wave: The third educational technology."

The theme of AMTEC 90 is particularly appropriate to postmodern ways of thinking. First, it is significant that the phrase "the third educational technology" is left delightfully ambiguous by the conference planners. Several intertextual connotations immediately come to mind.

Read with the syntagmatic "Catch the wave" phrase, we are drawn into the Alvin Toeffler world of "The third wave", the three waves of society being agricultural, industrial, and informational.

Additionally, "catch the wave" has meaning in popular culture as an advertising slogan (for Coke). Are the AMTEC 90 conference planners alerting us that educational technology is in danger of becoming too slick, too business-like? Or is it education which is being inappropriately treated as a commodity?

More significant is critical theorist Jurgen Habermas who has identified three parallel "knowledge constitutive interests", namely the technical, the practical, and the critical. These three paradigms have lately had a major impact on curriculum theory and are indeed the basis of postmodern knowledge. Following this view, the third educational technology would be a critical technology.

Further, Ivor Davies has discussed what he calls educational technology 1, 2 and 3. In his

designation the trichotomy refers to tools, systematic and systemic views.

With at least four seemingly divergent and even contradictory sets of directions, how can one even hope to "catch the wave" at all, let alone create one? This is the quintessential postmodern dilemma. Educational technologists must advocate a postmodern response which will integrate a technological solution with an educational system characterized by multiple views, a temporal nature, and complex needs.

Conclusion

So what is all the fuss about? So what? What is the relationship between Baudrillard's simulacrum and the project of educational technology within the everyday work of practising teachers? Belsey (1980) said it well:

> The object of the critic is to seek not the unity of the work, but the multiplicity and diversity of its possible meanings, its incompleteness, the omissions which it displays but cannot describe, and above all, its contradictions.

Learning must be more than receptive learning. It must include interpretive learning styles as well. Postmodern educational technology is supportive of Beckwith's (1988) search for a "systemic transformational field." Mitchell (1989) worries whether "the future of educational technology is past." Such a worry is perhaps not a worry at all, but precisely a part of the double coding and multiplicative analytic processes on which postmodernism thrives.

Afterword

First thesis: We know a great deal. And we know not only many details of doubtful intellectual interest, but also things which are of considerable practical significance...which provide us with deep theoretical insight and with a surprising understanding of the world.

Second thesis: Our ignorance is sobering and boundless...We also discover that where we believed that we were standing on firm and safe ground, all things, are in truth, insecure and in a state

of flux...

Third thesis: It is a fundamentally important task for every theory of knowledge to...[clarify] the relations between our remarkable and constantly increasing knowledge and our constantly increasing insight that we really know nothing.

(Popper, 1976, pp. 87-8)

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THE DYNAMICS OF COLLABORATION: FACTORS INFLUENCING COLLABORATION IN DISTANCE EDUCATION COURSE DEVELOPMENT

Wayne LaDouceur and Helen Geissinger

INTRODUCTION

The purpose of this paper is to identify and to examine the major factors which influence collaboration between institutions, and between their respective departments and faculty who agree to develop courses for distance education following the course team method. An identification of the major factors can help collaborators to diagnose problems of a project presently under development, and can help would be collaborators to identify potential problems and to predict the potential success of a project not yet begun. To this end, we have created a matrix (Table 1) which is derived from our experiences as instructional designers involved in collaboration projects.

We divide the operative dynamics in the matrix into the three principal areas of "Real", "Institution", and "Ego." The first area, somewhat speaks for itself. It covers the aspects of the collaboration which are usually discussed when negotiations and planning are underway. The institution area focuses on institutional aspects related to the collaboration, while ego deals with those factors which affect or are affected by the course team members. We identify "experience", "communication" "time", and "control" as the major factor categories common to all collaborative ventures. Weighted criteria statements appear under each of the three principal areas in each factor category. It is necessary to have a working definition of "ideal" collaboration before discussing the major factors which affect it. We regard ideal collaboration as a process or relational system in which all parties and individuals operate as a democracy, and coordinate their efforts to achieve a common goal. The collaborative process is marked by commitment, trust, and by a willingness to work interdependently.

MAJOR FACTORS AFFECTING COLLABORATION

Experience Factor

Certain assumptions about the potential success of a collaborative venture can be made based on the previous successful collaborative experience of the parties involved. If the institutions, departments or developers have been involved in a successful experience, they will likely be more willing to do it again, and to make a commitment to team work and to solving collaboration problems. Successful past experience also indicates a willingness to follow an instructional design model, and a willingness to deal with the stresses placed on the collaborative process. Former successful experience ultimately demonstrates success in identifying and meeting student needs, and indicates that the collaborators will likely be successful in meeting the needs of the prospective student population.

Communication Factor

Initially, the goals and the objectives of the project must be identified, and they must be unmistakably clear and understood by all individuals involved. In addition, the institutions must also put an organizational structure in place which facilitates effective and immediate communication. Most collaborating institutions select the traditional organizational approach to development (Figure 1) because they are accustomed to working with this structure. The traditional approach is not truly collaborative because its hierarchial nature does not readily lend itself to effective and immediate intergroup communication related to interaction, feedback, decision-making, or problem-solving.

Our concept of an "ideal" collaborative organizational approach to development is illustrated in Figure 2. Compared to the traditional approach, it is more holistic, and encourages open and effective inter-group communication amongst all of the participants regardless of their position in the collaboration. Its flexibility allows for all of the elements lacking in the traditional approach. This

collaborative approach epitomizes the definition of ideal collaboration presented in the introduction. A detailed explanation of this method is beyond the purpose and scope of this paper. It is in itself, a topic for a separate discussion paper.

Developer resistance to an instructional design model also has a great impact on communications. Some developers are opposed to following any design model because they feel that design models lack flexibility and stifle creativity. We have on a number of occasions, heard the instructional design process described as "assembly line" production. At this point, we could offer rationalizations for instructional design, but it would suffice to say that it is the blueprint to development, and offers structure and direction to the developers throughout the development process.

Resistance may also stem from a developer's fear of being placed in an unfamiliar situation. For most, collaboration is a new experience, an experience which calls for some "de-skilling," (Nisbet, 1974) or the willingness to set aside personal preferences and patterns of doing things.

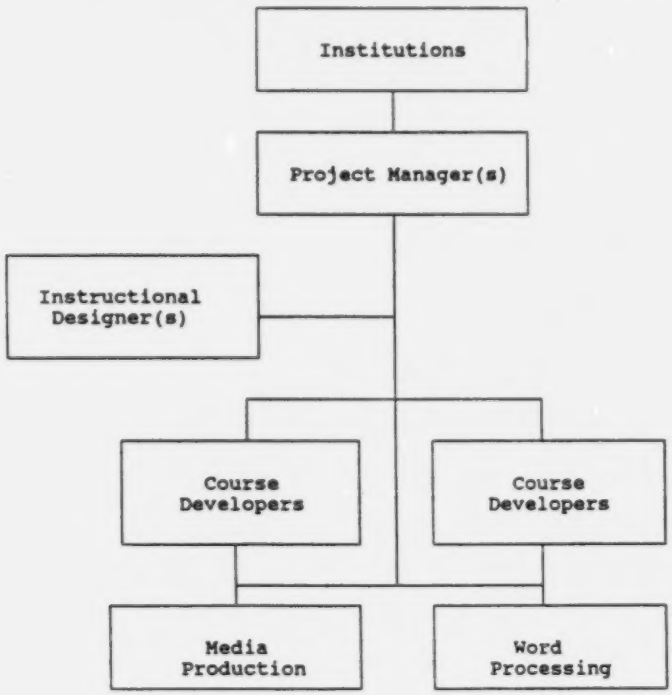

Figure 1. The Traditional Organizational Approach To Course Development

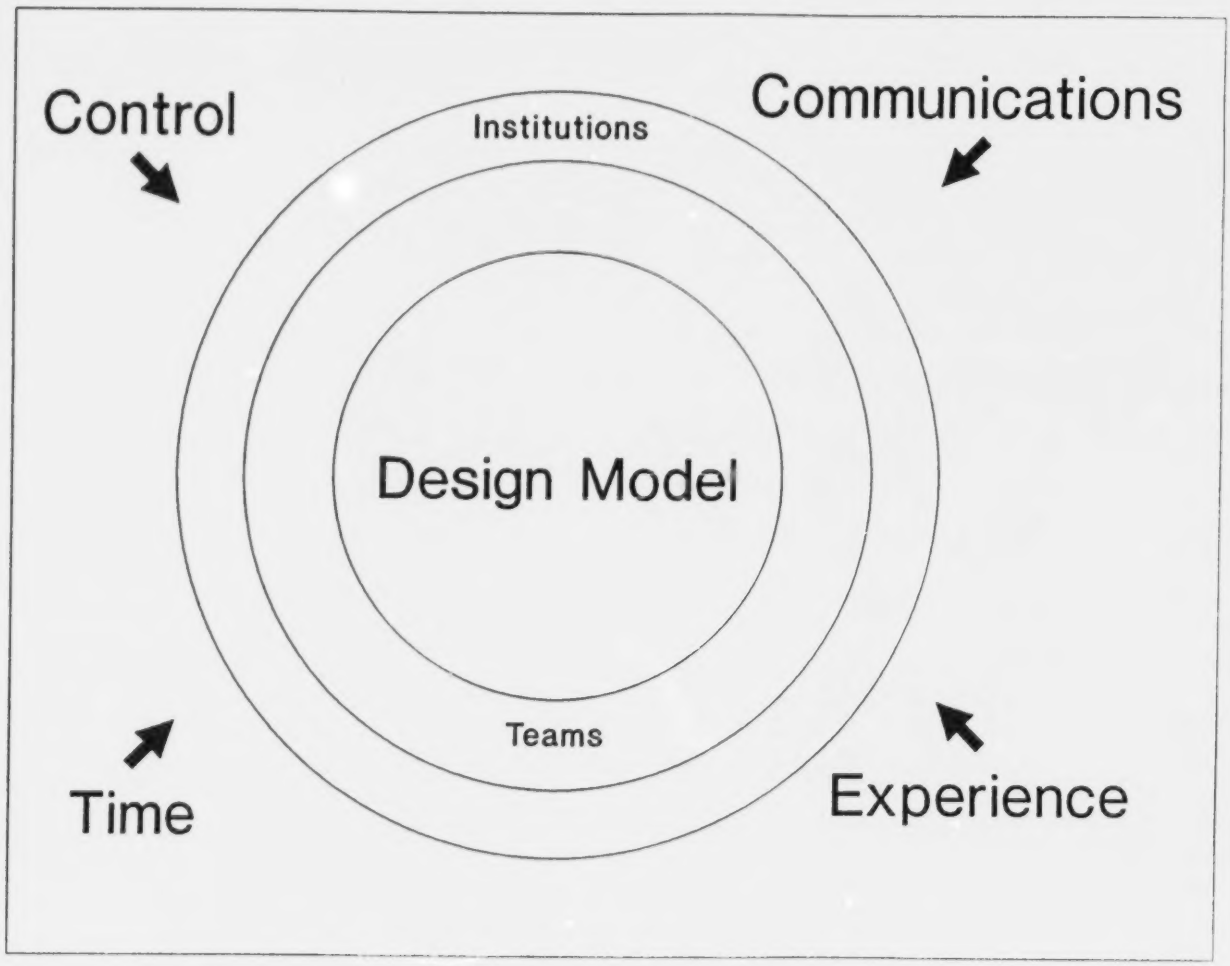

Figure 2. The Collaborative Organizational Approach To Course Development

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Time Factor

The production of related development materials, specifically audio-visual materials (including computer software), and the writing of course content are two activities which require a great deal of time. Over the course of development, members of the course teams may with the help of the instructional designer, identify the need for creating original audio-visual material or computer software to support the print components of a course. First time developers for the most part, usually have had little or no experiences with the technical aspects of the production process as classroom teachers. When they become involved in collaborative production, they find that they must invest a considerable amount of time to meet with other team members and with the media specialist to plan and to review the product throughout the various stages of production.

Ideally, course developers should be able to write course content in a period of time uninterrupted by other duties. However, many are paid a stipend and maintain their regular teaching load. They must therefore, develop their course on their own time and when time permits. Under these circumstances, time-conflicts are inevitable when the institutions' time lines for meetings and development activities do not realistically coincide with the developers' time lines.

Control Factor

Most post-secondary institutions have historically practised isolationism to promote their individualism. Consequently, the institutions, departments and course team members who are involved in a collaborative relationship for the first time, find it difficult to share control. Although they may support the collaboration in principle, some see it as a potential threat to their respective autonomy and identity.

Negotiations are required between all parties to address concerns and come to agreements about such items as stipends, standards of excellence, time release for development, ownership of materials, copyright, royalty payments and other related concerns. Instructional designers are not

normally involved at this stage however, much of what has been resolved or unresolved during the negotiation process becomes apparent to the designer at the beginning of development. It is essential that the professional and monetary rewards be realistically in line with the time, effort, and the expertise that developers are expected to contribute to the development process.

Using The Matrix

Upon examining the matrix, you will notice that each of the four factor categories and their respective criteria are weighted under the areas of Real, Institution, and Ego in the form of criteria statements. Select the criteria statements which are most applicable to your collaborative situation and assign them the weight indicated. Select only one statement from each grouping. Total all of the factor category points to arrive at your overall matrix point total. Compare your total score in relation to the matrix ideal score.

EXPERIENCE

	WEIGHT
1. Teamwork	5
2. Collaboration	10
3. Interest in proposed venture	5
4. Presence of a win/win attitude	5
5. Suitable model in place	10
6. Good knowledge base	5
7. Good problem-solving abilities	5
8. Recognition of clients' roles	5

REAL LIFE

Give all points in each category in which faculty/staff & institution experience with collaboration is recent and positive.

Give half points in each category where a small amount of experience has been gained.

Give zero points in each category where no experience has been gained.

Total: 50 points

INSTITUTIONAL

1. Give 10 points if the collaborating institutions or departments have a previous record of good teamwork.

Give 5 points if only one institution or department has a previous record of good teamwork.

Give 0 points if neither has a previous record of good teamwork.

2. Give 10 points if the instructional model is endorsed and supported by the department/institution.

Give 5 points if administration members are aware of the need for, and application of, a model.

Give 0 points if neither condition exists.

3. Give 10 points if administration in both institutions/departments actively & with good will help solve collab'n issues.

Give 5 points if one administration will do so.

Give 0 if both administrations ignore problems during collab'n.

Total: 30 points

EGO

1. Give 10 points if all members of the course team have had previous success with collaborative work.

Give 5 points if some of the team members have had successful collaboration experience.

Give 0 points if no one on the team has had successful experience previously.

2. Give 10 points if most team members show understanding of the factors which stress the collaborative process, i.e. the need for group decision-making.

Give 5 points if about half the team members can identify likely stressors on the collab. process.

Give 0 points if stressors are ignored or minimized. (If people say/think this topic should not be explored, they likely have little experience with the reality of collab'n.)

3. Give 10 points if all team members recognize there is more than one agenda to meet, such as that of the funding agency, the institution/department, the likely student population.

Give 5 points if most team members recognize there are several "clients" to please.

Give 0 points if student needs are given less consideration than those of the other clients.

Total: 30 points

TOTAL for all three factors: 110 points

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COMMUNICATION

	WEIGHT
1. Identification of goals and objectives	10
2. Clear understanding/acceptance of roles	10
3. Priorities expressed and settled by consensus	5
4. Recognition of contribution made by each member	5
5. Trust/confidence mechanisms establ.	5
6. Mechanisms are in place which will allow ready communication	10
7. Expectations stated in advance	5

REAL LIFE

Give all the points in each category in which the communication strategy suitable to the situation is present.

Give half points in each category where communication strategies are present, but not actively applied.

Give no points where the category has not been addressed in terms of communication.

Total: 50 points

INSTITUTIONAL

1. Give 10 points where the institutions/departments/funding agencies have goals which are clearly expressed among the parties.

Give 5 points where the goals are present, but not clear.

Give 0 where the goals are not given.

2. Give 10 points if the lines of communication are open within and between the collaborating agencies.

Give 5 points if mechanisms for communication are present, but not yet in operation.

Give 0 where the lines of communication are not identified, orthere appear to be blockages.

Total: 20 points

Give 5 points where this is an unknown factor but people seem interested in cooperation and team work.

Give 0 points where the attitude factor is unknown, but the team members have been assigned, rather than volunteering.

Total: 40 points

EGO

1. Give 10 points where expectations, goals & objectives are clearly expressed and consensus is desired.

Give 5 points where expectations and goals are expressed.

Give 0 points expectations, goals & objectives are not expressed and/or team members think expression of these is not important.

2. Give 10 points where team members are comfortable with their roles and responsibilities and are willing to trust others.

Give 5 points where team members are comfortable with their own responsibilities, but are reluctant to trust.

Give 0 points where neither condition is present.

3. Give 10 points where issues such as academic freedom, resistance to teamwork and/or deadlines and personality clashes are not present.

Give 5 points where issues such as these are identified, but mechanisms for dealing with them are in place.

Give 0 points where these issues exist but are either unacknowledged or no healing mechanism is in place.

4. Give 10 points where the team is composed of voluntary members with a positive, facilitating attitude and personal interest in the success of the project.

Total for all three factors: 110 points

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TIME

	WEIGHT
- Meetings	5
- Writing	10
- Proofing	5
- Review of others' work & circulation of comments to other team members	5
- Planning/ reflection	5
- Production:	
1. graphics, wordprocessing,	5
2. copy permissions	5
2. A/V media, software devel., planning, scripting, taping, post production	10

REAL LIFE

Give all the points in each category on which the time allocation is realistic. Give half points in each where the time allocation is only partly addressed. Give 0 where the time allocation is ignored or grossly underestimated.

Total: 50 points

INSTITUTIONAL

1.Give 10 points if the two institutions (departments) give synchronous time for faculty/staff to do the development.

Give 5 if time is relatively coordinated.

Give 0 if some faculty are working on overload or on own time, while others are on load time.

2. Give 10 if the time devoted to course devel. is paid specifically for the work involved.

Give 5 if more than half of the members are paid specifically for their work.

Give 0 if fewer than half are paid specifically for their work on course devel.

3. Give 10 if production staff & facilities are available for development work at times suitable for the team's time lines.

Give 5 if production staff & facilities are available as the team needs them more than half the time.

Give 0 if there are serious problems freeing up production staff/facilities.

Total: 30 points

EGO

1. Give 10 points if each member estimates the time required for the major tasks appropriately.

Give 5 points if over half of the team members can estimate time requirements for major tasks realistically.

Give 0 points if team members assume they will have no problem with writing/development work.

2. Give 10 points if faculty show good understanding of the production time lines of technical & support staff.

Give 5 if there is some understanding of the production time lines of technical/support staff.

Give 0 if faculty do not have this understanding.

Total: 20 points

TOTAL for all three factors: 100 points

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CONTROL

	WEIGHT
1. Budget	10
2. Politics	5
3. Rewards	10
4. Collaborative mechanisms	5
5. Quality product	5
6. Copyright	5
7. Recognition of team leader	5
8. Role of Advisory Board or external review	5

TOTAL for all three factors: 120 points

REAL LIFE

Give all points in each category where control lies with the team.
Give half points in each category in which control is partially exerted by the team.
Give zero points in each category where control is external (or cannot be identified).

Total: 50 points

INSTITUTIONAL

1. Give 10 points if the budget is adequate to reward team members appropriately.

Give 5 points if the budget awards team members some monetary reward.

Give 0 points if everyone is working for straight salary.

2. Give 10 points if the budget is adequate to allow production of high quality materials.

Give 5 points if the budget allows production of better quality materials than run-of-the-mill.

Give 0 points where quality production is not a budget aim.

3. Give 10 points where the holistic model of team/course development is used.

Give 5 points where a model is used which resembles the holistic model in many ways.

Give 0 points where the traditional model is used.

4. Give 10 points where there are outward checks and balances, such as external review/Advisory Board.

Give 5 points where there is some external auditing.

Give 0 points where there is no external review.

Total: 40 points

EGO

1. Give 10 points if team members think the rewards (monetary or other) are adequate.

Give 5 points if the team members think the rewards are somewhat inadequate.

Give 0 points if the team members think the rewards are not at all adequate.

2. Give 10 points if team members perceive the value of working together, even if inexperienced with this kind of endeavour. It means they will relinquish some areas of personal control for the good of the team.

Give 5 if some members are willing to contribute unselfishly, even when identified others are not.

Give 0 where the chance of pulling the team together seems very difficult.

3. Give 10 points if team members are willing to make a commitment of time and skills/resources to incorporate the needs of the clients into the expected outcomes.

Give 5 points if the clients' needs have been recognized in at least one agreed-upon objective.

Give 0 where the clients' needs are not allowed to exert some control on the team's work.

Total: 30 points

Total Points for Control, Experience, Time and Communication: 440

Conclusion

The process of collaboration is indeed a complex one. Collaboration will only work if there is a willingness to trust and to work interdependently. There must be a coordinated effort to identify and to deal constructively with the dynamic factors which influence the collaborative undertaking, and to recognize the need for, and adoption of, an holistic collaborative approach to development.

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THE LIMITATIONS OF THE STRUCTURED INTERVIEW AS A DATA-GATHERING TECHNIQUE WITH NON-ELITE SUBJECTS

Genevieve Gallant and Mary Kennedy

Judge a man by his questions rather than by his answers.

Voltaire

INTRODUCTION

In the past two decades there has been an expansion of research methodologies deemed applicable and suitable to research in education to include qualitative research methods - that family of methodologies which have for a century or more been used extensively in the social sciences.

What are qualitative research methods? Qualitative methodology, according to Bogdan and Taylor (1984), "refers in the broadest sense to research that produces descriptive data; people's own written and spoken words and observable behaviours" (p. 5). The role of description in the social sciences cannot be over-valued, since it provides the basis for grounded theory; theory that is based in the real world of observable phenomena (Guba and Lincoln, 1982).

Qualitative methodology is more than simply a group of data- gathering techniques. It is a way of viewing and approaching the empirical world. It most often relies on the human being, the researcher himself or herself, as both the architect of the research study and as the main instrument used in carrying out the study.

Guba and Lincoln (1982) note that there are three main kinds of human-to-human measures for collecting data: interviewing, observation, and non-verbal communication. Of these perhaps the most respected and most enduring is the conversation. "Interviewing, the 'conversation with a purpose' (Dexter, 1980,p. 136) is one of the oldest and most respected of the tools a qualitative researcher can use" (Guba and Lincoln, 1982, p. 154).

The interview takes many forms and can serve many purposes. Interviews can range from highly structured - resembling an orally administered questionnaire - to totally unstructured. They can be conducted singly or with a group; by one interviewer or by a group of interviewers. The response range can be closed (permitting a single response frame only) or open (permitting the subject to respond in his or her preferred speech). Interviews can also be categorized as elite or non-elite. According to Guba and Lincoln (1982) the structured interview is most appropriate when the problem is defined by the researcher and it is known what information is to be sought. This type of interview is frequently used with non-elite subjects - those respondents who do not hold specialized information, "and who are expected to respond in terms of the researcher's definition of the problem and frame of reference" (Guba and Lincoln, 1982, p. 155). The unstructured interview, used with "elite" subjects, has a non-standardized format, and is concerned with seeking out the subject's "unique, idiosyncratic and wholly individual viewpoint" (Guba and Lincoln, 1982, p. 156). The researcher is most likely to use elite interviews when he or she is dealing with subjects with special knowledge or status, and/or when it is beneficial to pursue some topic in depth.

Patton (1982) describes three approaches to open-ended interviewing (p. 162). The informal, conversational interview is totally unstructured, and proceeds through the spontaneous generation of questions, each flowing from the previous response. The general guided interview is conducted with the aid of a prepared list of questions or issues which serves as a basic checklist to ensure that all relevant topics are covered. The guide is not meant to order the interview nor to limit the discussion to only those questions included. The standardized open-ended interview is highly structured, consisting of a definitive set of ordered questions, which is meant to provide each subject with the same interview experience. It reduces the possibility of bias that exists in having different interviewers for different people. Patton(1982) notes:

> the standardized, open-ended interview is particularly appropriate when a large number of people are to conduct interviews on the same topic

> and the researcher wishes to reduce the variation in responses due purely to the fact that, left to themselves, different interviewers will ask questions on a single topic in different ways" (p. 165).

The Studies

The researchers used, as a data gathering technique, the standardized, open-ended interview in a qualitative research study conducted last year. A parallel study was completed at the same time using the written questionnaire as the data- gathering instrument. The selection of these particular data-gathering methods was based on the "best fit" given the parameters of the studies. Because the researchers worked on both studies, the limitations of the structured interview as applied in qualitative research can be considered in both relative (compared to the written questionnaire) and absolute terms.

Both research studies were conducted to determine instructional development knowledge and competency levels among two groups of educators. These two studies are part of an ongoing series of studies on instructional development implementation in various educational milieus.

The first study was a survey using a written questionnaire. It involved approximately two hundred randomly selected primary and elementary classroom teachers at a large urban school board. While cognizant of the problems inherent in the mailed questionnaire, it was deemed most efficient in that classroom teachers have very little in-school time for interview schedules, and the interviewing of such a large number of subjects would be very costly and time consuming, as would other qualitative methods such as observation.

The second study involved the whole population, totalling one hundred twenty-eight, of teacher-librarian specialists throughout the province. The methodology was qualitative; originally conceived as an unstructured interview with elite subjects. But because of the need to use multiple interviewers in the field the researchers determined that the study would be less biased if the structured interview format were followed. Hence they sacificed relevance for rigour, as Guba and Lincoln (1982)

would note.

In both studies essentially the same information was sought. Both the questionnaire and the structured interview contained a number of questions about the concept of instructional development as a whole. These included items on definitions and explanations, items on responses to different levels of instructional development - i.e. functional, systematic versus conceptual, systemic - and items on the application of instructional development in the subjects' setting. Both data gathering instruments also contained numerous items on thirteen recognized components of instructional development, such as needs assessment, task/concept analysis, behavioural objectives, and the like. Questions probed subjects' specific knowledge of and competency in each of these components.

The main differences in the written questionnaire and the structured interview, from a design perspective, lay in the amount of detail included and the response range. Of forty- five items on the written questionnaire (exceedingly long for this type of instrument) thirty-nine were closed response- subjects were provided with two, three, or four response options and asked to select the one which they felt best represented their views. Six items required brief, open-ended answers.

The interview guide contained seventy-seven questions, sixty four of which required open-ended responses. Subjects were expected, and indeed encouraged, to answer at length using their own verbal structures.

The Results

The results of the study using the structured interview were interesting. These teacher-librarians, according to their role as delineated in various professional and provincial standards, are expected to function in essence as instructional developers, collaboratively developing instruction with classroom teachers through consultation. Through the open-ended response interview it was obvious that knowledge of and competency in instructional development is minimal. All questions elicited a wide response range: when responses were content analysed semantically and categorized it was

determined that the overall response range was from eleven to twenty-five separate answers.

While there may not be an absolutely correct or incorrect answer in terms of exact phrasing in such a study, researchers did determine a priori the main elements required within each response to indicate knowledge or competency. Once again using semantic content analysis, the response categories were compared with the a prior determined responses and judgements were made about knowledge and competency levels of subjects.

Responses were interesting in their diversity. Rather than lengthy the responses were generally brief, often only one sentence or so. Researchers found, as anticipated, that the diversity of responses was greatest on items which indicated little knowledge or competency. When asked to explain in their own terms "instructional development" there were twenty separate response categories.

It was also found that responses became extremely vague and general when not backed by a knowledge base. For example, when asked to explain what was meant by "task analysis" common responses were "tasks to be done" and "tasks of the teacher" - both so vague that they are meaningless. The subjects, when faced with questions which challenged them, were reluctant to admit that they did not have specific knowledge, and time and again they would draw on general teaching experience to claim knowledge of instructional development. Usually a question on an aspect of instructional development which subjects did not know much about elicited a response which began with an introductory statement such as "Gee! I don't know if I can put that into words..." followed by a rambling vague description of generic teaching strategies.

Responses were frequently accompanied by non-verbal cues, which interviewers recorded in a separate column alongside the appropriate place in the field notes of the verbal exchange. Signs of relief - relaxing of shoulders, posture, and accompanying relaxed facial expression or even a smile were often noted when subjects were asked a question on some aspect of instructional development which they felt knowledgeable about, especially if such a question followed on a particularly difficult set of questions. Similarly non- verbal signs of discomfort such as tipping back and looking away, avoiding

eye contact, squirming, tensing of shoulders, and nervous tapping on the desk were frequently noted when subjects did not exhibit knowledge or competency in a given aspect of instructional development. Such non-verbal signs of discomfort were often supported by statements such as "I really should know that" or "Isn't it awful - I can't remember."

Limitations of the Structured Interview

The structured interview as a data-gathering method proved to be vastly superior to the written questionnaire. The latter, besides being severely limiting in terms of the number of items which could reasonably be included if one were to expect a respectable response rate, was also limiting in terms of the type of items which could be included. The items could not be open-ended for the most part because it was anticipated that a questionnaire which could not be completed within twenty to thirty minutes would not be completed. It was necessary, then, to provide responses to questions and have subjects select the best response - a multiple choice design. From the perspective of measuring knowledge and competency levels of instructional development, this was not the most ideal approach. Subjects were already provided with a frame of reference for each item. And of course there was no opportunity to interact with subjects and glean valuable extraneous data via asides, informal commentary, and non- verbal cues.

But despite the superiority of the structured interview to the written questionnaire, limitations were obvious to the researchers. Time and again in the interview situations responses indicated that it would be beneficial to ask a follow-up question, but because of the standardization of the interviews these "leads" were ignored. Probing, as defined in the qualitative research literature, was not possible. And while the researchers tried to build into the interview guide a number of probing questions, they were scheduled probes as opposed to probes which emerge naturally in conversation.

The structured interview made it difficult to maintain rapport. At the beginning of each interview situation, the interviewers made "small talk" for the purpose of building rapport. It was during these

preliminary conversations that the purpose of the interview and the protocols for conducting the interview were explained, and subjects raised any questions they might have regarding the process. Through such informal, conversational interchange, which often lasted up to fifteen minutes, the subjects were made to feel comfortable, were relaxed, and a rapport was established between interviewers and subjects. However this rapport dissipated rapidly once the interviews began, because immediately all control over the ensuing "conversation" reverted to the interviewers. The subjects' only control resided in their willingness to provide responses, and they felt obliged to respond since they had made a prior commitment to be interviewed when first contacted.

Related to the issue of difficulty in maintaining rapport during the structured interview process is the issue of embarrassment. The face-to-face nature of the interview, in a situation where it became clear as the interview progressed that the interviewer was setting the agenda, created discomfort when the subject was presented with questions which he or she could not readily answer. Since questions were arranged in each section to range from general to specific, there might be, at times, as many as three or four questions in a row which the subject was unable to answer adequately. But because of the structured format each question had to be asked in turn. Many subjects found this experience embarrassing, since they felt that they should, as teacher-librarians, be knowledgeable about the subject matter.

In addition to such substantive limitations there are also administrative/managerial limitations to the structured interview. The cost of conducting research using this methodology with a large group of subjects is prohibitive. In this particular study travel was also involved, and travel time, plus travel expenses, plus interview time made some interviews cost as much as $100 each - a very high cost for approximately one and one half hours of data gathering from a single subject.

Related to cost is the issue of time. The structured interview is also a very time consuming way of collecting information. Since each interview is conducted with a single subject, the time consumed, when compared with a mailed questionnaire to hundreds of subjects, is exhorbitant. Of course there are

obvious advantages to the interview, as opposed to the mailed questionnaire, which were discussed earlier.

Perhaps the greatest procedural limitation is the lack of trained interviewers. Preparatory programs in education do not, as a rule, provide training in or study of qualitative research methods, hence most graduates are not familiar with the methodology. If there is a need to use a number of interviewers it is necessary to provide at least one training session before interviews are conducted. And even with the provision of rudimentary training the interviewers are far from the ideal in terms of the "human instrument" as described by Guba and Lincoln (1982). They can be easily trained in the basic procedure to be followed, but the art of non-judgemental listening, of controlling biases, of controlling non-verbal expressions, of picking up on the subjects' non-verbal communications, of being at ease in the interview situation, of recording data while actively participating in the process, cannot readily be developed in one hour of training.

Summary

The structured interview method is not truly qualitative, in that the researcher enters the setting with predetermined purposes and preconceived notions, and imposes his or her view of reality on the setting. Such limiting or defining of the milieu can prevent the disclosure of "unanticipated events" or interesting side effects.

The structured interview, conducted with subjects who are not deemed to have special status or access to special information by virtue of their position, is an interesting data-gathering method. It provides a rich data base. But at the same time it imposes structure on a situation which would best be left fluid, it ensures that control lies with the researcher rather than being shared with the participants in the study, and it prevents the pursuit of interesting data leads. The very strength of the qualitative research approach lies in the provision of the capability, on the part of the researcher, to explore and discover, to follow any interesting paths which appear. The structured interview falls short of permitting

exploration of such pathways.

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INTERACTIVE INSTRUCTION
AN EXPLORATION OF SOME CRUCIAL ATTRIBUTES

James J. LaFollette

INTRODUCTION

As the number of individual and integrated technologies available for instruction increases, proponents have lauded their potential. This has been particularly true of technologies incorporating the laser videodisc interfaced with a computer, as well as other optical disc technologies (e.g. Donahue & Donahue, 1983; Bunderson, Hoekema, Hon, Wilson, Worcester, & Woodward, 1983; Van Horn, 1987); On the other hand, it has been proclaimed that research clearly suggests that no learning benefits can be gained by employing any specific medium to deliver instruction, regardless of learning task, learner traits, symbolic elements, curriculum content, or setting (Clark, 1983; Clark & Salomon, 1987).

The inherent characteristics of a medium (especially the symbol systems utilized) are its defining attributes. Further, we may distinguish between the inherent attributes of a medium and imposed attributes, such as environmental and design factors. If the psychological effects of a presentational medium are considered in terms of the contribution they make to specific educational outcomes, our concern is with the effects of specific media characteristics on specific individuals and with the functions they accomplish relative to given instructional tasks (Salomon, 1974). Recently the assumption that there is a one-to-one correspondence between coding elements and afforded activities, on the one hand, and specific modes of mental representation on the other has been questioned (Clark & Salomon, 1987). Still, a useful classification distinguishes structural media attributes from functional media attributes to facilitate differentiating media on the basis of their function for influencing and activating different kinds of learning processes (Heidt, 1977,1978).

The goal of this paper will be to explore attributes of mediated learning resources, learners and instructional design which appear to be crucial in determining the interactive capability and potential for

instruction of any given instructional technology. Three significant dimensions will be examined.

A Sensory Dimension, which includes structural media attributes and also incorporates an imposed communication variable, message treatment. The Processing Dimension relates more closely to functional media attributes, however it will be approached primarily from the perspective of what the learner brings to the media. Finally, a Control Dimension is introduced, represented by a continuum from total control exercised by the program designer to the ability of the learner to manage the learning situation completely free of program control. Figure 1 displays possible relationships among these dimensions.

THE SENSORY DIMENSION

In terms of the internal operations of the learner, we need to consider how the structural attributes of a medium used as a technology for instruction can be utilized as functional attributes which facilitate effective mental processing. Based on the assumption that the factors which underlie the use of media for instruction are the symbol system, the message, the learner, and the educational task (Salomon, 1974), our Sensory Dimension relates to both the symbol system and the message. The Processing Dimension essentially treats the learner's interaction with the symbol system, the message, and the task. The Control Dimension deals with selected aspects of the task, although overlap with the message is obvious.

A classification placing symbolic modalities into categories of digital signs and iconic signs (Levie, 1978) has been used. As noted by Knowlton (1966), digital signs are essentially arbitrary and do not have natural referents, while iconic signs tend to bear a resemblance to something for which they stand.

Salomon's conclusions that the symbol system, rather than the technology of transmission is crucial for instruction, and that symbol systems are the primary, most essential attributes of media (1974, 1979), provided a point of departure from treating media as global, holistic entities. However,

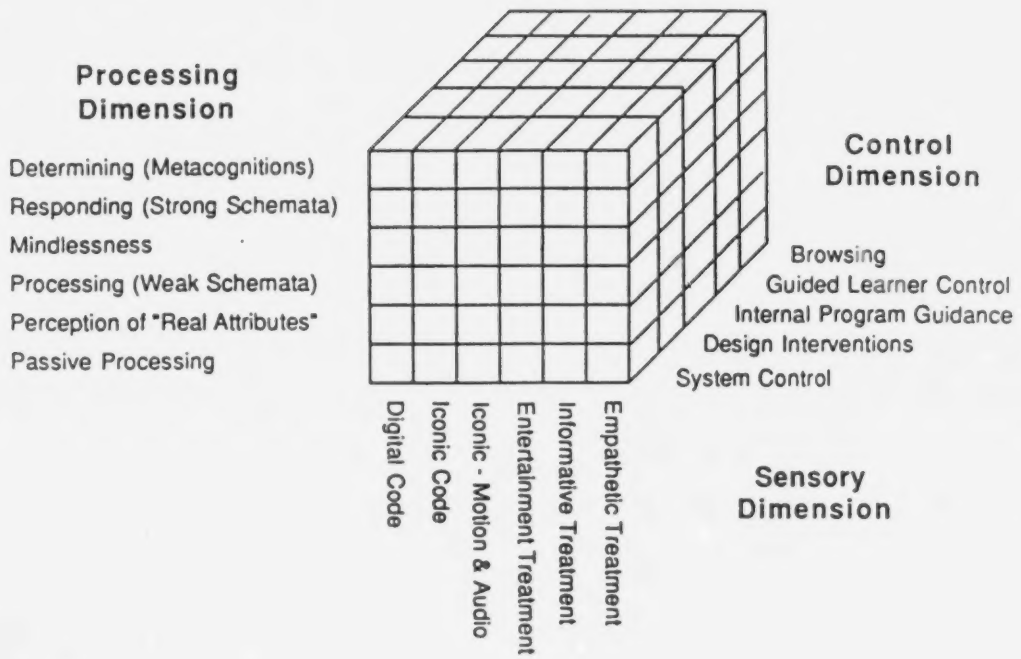

Figure 1. Crucial Attributes of Interactive Instruction: Three Dimensions.

other aspects of symbol system theory may be less secure. In particular the assumption "that cognitive representations and processing are carried out in various symbolic modes that are influenced by the symbol systems employed by media, that some of these cognitions are unique counterparts of communicational symbol systems, and thus can be cultivated by symbol systems" (Clark & Salomon, 1987, p. 469), has been challenged.

For the purpose of examining the attributes of instructional systems, the concept of symbol systems is useful. Based on Goodman (1968) an important means of analysis is notationality. A notational system (e.g. languages; musical notation) consists of a set of separate, discontinuous characters correlated with a field of reference which is further segregated so that any character in the system isolates the object or objects it stands for. In contrast, nonnotational systems (e. g. pictures) are continuous and unsegregated with no set of isolated characters (Gardner, Howard & Perkins, 1974).

A related aspect of the Symbolic Dimension has to do with perceptions of reality in the light of potentially vicarious mediated experiences. Several researchers have studied people's perceptions of reality while viewing television. Dorr (1983) suggests various criteria which people use to judge reality: it can represent a simulated experience in which characters, actions, messages, or themes in some way conform to real life; that something is judged real if it is deemed possible; or that a presentation is only judged real if it is considered probable or representative. An extensive general knowledge of physical and social reality would need to be called upon when applying the above criteria. Considered from the viewpoint of the phenomenological school of philosophy, perceived reality can evolve through "bracketing" or the willing, but temporary, suspension of disbelief. The physical world isn't eliminated, but people simply disengage from it by bracketing it out and accepting the content and context of the media as real (Jonassen, 1984).

Digital Codes

Digital signs as a symbolic modality should also be considered in terms of sensory modality.

Common examples of digital signs in the visual modality are printed words, numbers, and semaphore code. Spoken words represent by far the most common auditory form of digital signs, although morse code and alarms constitute other examples (Levie, 1978).

A human processing system specialized for processing temporal, sequential verbal symbols can function independently. Of greater interest to our search for crucial interconnections among attributes of interactive instruction is the concept that human information processing involves the verbal symbolic system in interaction with an imaginal symbolic system (Paivio, 1971). "Thus, language can activate representations of nonverbal objects and events, which may be experienced in the form of mental imagery. Conversely, nonverbal objects and events, or mental images, can be described" (Paivio, 1983, p. 206).

Iconic Codes

The human imaginal system is specialized for processing spatial, simultaneous information of a relatively concrete nature. The system is also considered to perform independent operations, called "mental imagery", or "visual thinking". Iconic signs in the visual modality include pictures, statues, and gestures. Iconic signs in the auditory modality include sound effects and music (Levie, 1978). Although these symbol systems are low in notationality, they should not be considered easier nor more difficult to comprehend or learn than other systems (Gardner, et al, 1974; Clark & Salomon, 1987).

Iconic - Motion & Audio

Formal attributes of audiovisual presentations include action, pace, visual techniques, and verbal and nonverbal auditory events. Such attributes result from production and editing techniques and are defined independently of content. Formal features are often used as signals of content likely to come. Many production conventions are not shared across cultures, different forms of the same medium, or across different media (Huston & Wright, 1983).

Numerous studies have analyzed the relationship between formal attributes and visual attention. Many of the studies involved children, but the results are interesting in terms of their potential relevance for learners of all ages. Production features which tend to maintain and elicit the attention of young children include motion, audio change, and sound effects (Anderson & Lorch, 1983)

Formal features of television which possess the quality of perceptual salience were identified by Huston & Wright (1983). Attributes identified as salient include physical activity of characters, rapid pace, variability of scenes, visual special effects, loud music sound effects and peculiar or non-human voices. Features identified as lacking perceptual salience included human speech, physical inactivity, and background music. Moderate action and zooms were classified as having moderate perceptual salience. Perceptually salient attributes have much less influence on the attention and comprehension of older children and adults than on very young children.

The effect of formal attributes is influenced by the learner's greater familiarity with a medium's attributes, developing cognitive skills, linguistic and imaginal competence, and cultural knowledge.

Treatment: Entertainment; Informative; Empathetic

Our discussion of the Processing Dimension will suggest a reciprocal interaction involving a learner's cognitive capacity and the instructional environment. The reciprocal paradigm implies a limited role for media attributes, however, communicational treatment provides one possible area of influence. The concept of treatment relates to the manner in which the content, code, and structure of an instructional system is organized and presented. Broad treatment forms include "expository", a straightforward informational presentation; "dramatic"; and "personal involvement" (Kemp & Smellie, 1989).

Treatment can also be considered an aspect of communicational intent. It is possible to distinguish between different kinds of communicational events according to their perceived intent: intent to entertain; intent to convey (inform or share); and intent to change (Salomon, 1981).

Familiarity with the formal attributes of popular media could be a possible recommendation for using an entertainment treatment for instruction. Research results suggest otherwise. For example, Ksobiech (1976) found that university undergraduates who were told that a televised lesson would be entertaining performed poorly on a subsequent exam, compared to a group who were told they would take a test following the presentation, and another group which was told they were to evaluate the lesson.

Messages with treatments which convey the perception that the communicator is definitely attempting to influence, or persuade the receiver will tend to be seen to limit one's freedom of thought or choice, and consequently are likely to be countereffective. Events which convey the perception that the only intent is to convey, or share information are considered more effective (Salomon, 1981). However, potential problems with excessive use of sterile information treatments could exist. Informative and interesting would seem to be a minimal guideline, calling upon the creative talents of instructional designers. A possible approach involves dramatic treatments which convey the communication intent of conveying information.

Some of the communicational intent of designers, even when the principal goal is to inform, includes persuading (motivating) the learner to accept the message as well as processing the information. The personal involvement treatment could counteract negative effects, but is difficult to carry out. An area of possible exploration would be to attempt what might be called an empathetic treatment. The goal would be to demonstrate the personal value of the communication to the receiver, in order that the attribution of intent would not be perceived as promoting the vested interests of the communicator.

THE PROCESSING DIMENSION

A popular assumption suggests that external forces strongly influence an individual's knowledge acquisition, attitudes, behaviours, and cognitive skill mastery. Another assumption supports the view

that external forces exert their influences through the mediation of already existing cognitive structures, which set the limits on the magnitude and qualitative nature of the external effects (Salomon, 1983).

Thus, a dominant view suggests that learners are reactively controlled by media and instructional displays. The learner is perceived as an active responder to the medium's demands. The medium can be said to differentially activate cognitive or emotional responses from individuals with particular cognitive abilities or tendencies. The nature of the responses depends jointly on the attributes of the medium and on those of the individual (Salomon, 1983; Anderson & Lorch, 1983).

An alternative view contends that attention to instructional displays is actively under the control of the learner. The learner is perceived not only as a responder, but also as a potential determiner of the experience. Learners do not necessarily respond to the "real" attributes of the medium but apply to it their own often culturally shared perceptions and attributions (themselves the partial results of prior exposure to the media), which in turn affect the kind of experiences the learner encounters (Salomon, 1983; Anderson & Lorch, 1983).

There is reason to believe that the two perspectives are complementary. Cognitive social psychology contributes the assumption that people actively affect their environment through their personal and socially shared perceptions and they experience the consequences of their activity in a reciprocal, rather than linear fashion. "Thus, from the social learning perspective, psychological functioning involves a continuous reciprocal interaction between behavioral, cognitive, and environmental influences" (Bandura, 1978, p. 345).

People are affected by their environments, but they influence their environments as well. Thus, efforts to account for the impact of mediated instructional systems should consider what the learner brings to the setting at least as much as what the system presents to the learner (Anderson & Lorch, 1983).

Figure One, in a general way, represents a continuum of processing. The stages: Perception of "Real Attributes" and Processing (Weak Schemata) basically represent a traditional S-O-R model of

learning where the O represents internal processing which links the stimulus and the response. Here attention and reaction to the environment and its displays is dominant. The stages: Responding (Strong Schemata) and Determining (Metacognitions) represent a cognitive processing paradigm where previously developed schemata incorporating previous skill, information, and knowledge guide the learner's perception and largely determine present and future interactions. The stages: Passive Processing and Mindlessness represent aspects of each paradigm where superficial, automatic, or an absence of processing takes place.

It is suggested that both processing paradigms operate as a learner encounters instructional displays and that they usually act in concert (Salomon, 1983). Top-down processing is guided by anticipatory schemata typical of search behaviour , while bottom-up processing is guided mainly by the saliency of stimulus properties. "Apparently, the more one knows about a topic, and the better a new unit of material fits into a preexisting frame, conception, or schema, the more top-down processes dominate (assimilation); when the material is relatively novel (but not too novel) and being handled by impoverished schemata, bottom-up processes dominate (accommodation)" (Salomon, 1983, pp. 185-186).

Passive Processing

Instructional media and instructional systems have often been classified as "message or stimulus" oriented or as "response" oriented. Stimulus oriented media are characterized by their emphasis on input to students, a message and its design, and very little concern with the explicit nature of the response(s) students are to make to a particular message or portions of it (Gropper, 1976). While clearly taking a response oriented approach, Gropper labelled media which do not themselves impose the conditions thought to be necessary for learning, such as use of feedback, as passive. Such media as films, television, radio, slides, slide-tape, audiotape, and print were identified as passive carriers. Active carriers (e.g. programmed instruction, CAI) deliberately and systematically dictate particular

conditions for learning. Such classifications may have contributed to common perceptions that motion pictures, television and other presentation media facilitate only passive processing.

Termination of attention, the equivalent of passive processing, would be expected to occur if presented material were sufficiently unfamiliar or difficult and the learner was unable to activate and apply a comprehension schema (Anderson & Lorch, 1983).

Processing of popular media has been considered, if not passive, at least reactive as opposed to active. Extrapolation of this approach to instruction suggests that an audiovisual medium elicits and maintains attention via salient formal features, both visual and auditory. The direction of influence is from the medium to the learner. The influence of learner intentions, plans, strategies, and previous experience are minimal. Relatively automatic comprehension and retention processes are assumed to occur, once attention has been gained (Anderson & Lorch, 1983).

Perception of "Real Attributes"

Salomon (1981) suggests that media can induce "naive changes" to schemata when the schemata are weak, poorly integrated, isolated, not salient, not important, or not readily available. Perception of content of an instructional presentation may occur when the salience of the formal features elicit and maintain attention to the system. This has been equated with a type of "exploration" as the learner responds to immediate, salient, discrete aspects of the stimulus setting. Exploration is most common when the learner is unfamiliar with the situation being presented (Huston & Wright, 1983).

Processing (Weak Schemata)

Exploration may be said to move gradually to perceptual search when the learner is guided by internally generated goals, rather than by external sensory events. At this stage some of the features that attract attention may be perceptually salient, but learners are attracted to the display features

because of their informativeness or relevance to personal goals, rather than on their perceptual characteristics (Huston & Wright, 1983).

Mindlessness

Mindlessness, or stereotypical reenactment represents the absence of active conscious processing. It has been shown that people engage in mindless behaviour when they encounter events that appear to them as highly familiar, overlearned, and repetitious. Individuals engaged in mindless activity may give the appearance of mindful action, but new information is not actually processed. In particular, when the structure of a communication is congruent with a receiver's past experience, it may result in behaviour which is "mindless" of relevant details. (Langer, Blank & Chanowitz, 1978). Thus what learners are capable of doing is not necessarily what they actually do. The mindlessness phenomena would seem to account for the performance of learners who appear quite capable, but continually fail to master curriculum goals, despite repeating the same material several times.

Responding (Strong Schemata)

It is at this stage that prior knowledge and skills, which are stored in the schemata and are available for processing come into play. Thus, the essence of the "reciprocal paradigm", which "postulates that personal dispositions, attributions of intent and meaning, communicational behaviours, and educational outcomes are reciprocally related to each other. We are influenced by others' messages, but it is our (often a priori) interpretation of the messages that influence the way we are influenced" (Salomon, 1981, p. 211).

Even though the schemata may be well integrated, salient, and important in the learner's repertoire, media can influence changes to schemata which are insufficiently developed to handle certain novel events. Such actions have been characterized as information seeking (epistemic) processes (Salomon, 1981).

Determining (Metacognitions)

Metacognitions (metarules) tell us when, under what conditions, and for what purposes we are to apply schemata. Learners influence the way they interact within an instructional system, not just by responding through the skills and knowledge the system evokes in them, but also through metacognitions that they apply to it. Learners may also develop new internal strategies about how to learn as they interact with an instructional system. At this stage the learner is determining not only what material will be processed, but also how it will be processed. We could expect learners to apply alternative schemata, if available, depending upon their intentions, goals, and perceived demands of the setting (Salomon, 1981; 1983).

THE CONTROL DIMENSION

A crucial aspect of interactive instruction which relates to the learner's processing of the media within a complex instructional system is the manner in which the system permits control during learning. Under learner control, adaptive instructional decisions are made by the student, in contrast to system control where instructional decisions (adaptive or linear) are made for the student. Design decisions along this dimension, in interplay with the learner and the medium would seem to determine the true nature and quality of the interaction involved.

It seems evident from our discussion of the "Processing Dimension" that even in situations in which the presentations are selected for, sequenced for, and paced for the student, a great deal of learner control will still be exercised by the student. Concluding that all instruction involves some learner control, Merrill (1984) suggests that "the challenge is not whether or not learner-control should be made available, but rather how to maximize the student's ability to use the learner-control available (1984, p. 239). There is little positive evidence favouring total, unaided learner control. Research indicates that learner control with some form of coaching has been consistently superior to unassisted

learner control (Hannafin, 1985). Thus, "The capabilities of the learners to use control options effectively is a more salient consideration than the capability of the technology to permit control" (1985, p. 243).

System Control

System control of instruction is characterized as external, and is identified with instruction in which all learners follow a predetermined route established by the designer without using individual judgement as to the appropriateness of the path (Hannafin, 1984). Externally controlled CAI has proven effective in drill and practice tasks involving lower order intellectual skills (Hannafin, 1984), however the evidence suggests that contextual and substantive information and higher order skills may be best taught using learner control (Kulik, Bangert, & Williams, 1983).

Although some CAI and Interactive Video instruction has been designed along the lines of a linear programming model, system control does not necessarily connote a linear approach. Tutorial CAI is more the ideal. An example of rigid system control is a version of tutorial CAI, based on a performance or response driven adaptive instructional model. The learner is given practice problems as part of the presentation and the next display is determined from the response. Any adaptation is the same for all learners, but if some branching is used, a learner would see one display if the response to the previous frame was correct, and a different one if it was incorrect. It has been suggested that provided the content is fixed, such a system is similar to a lecture, and even more limited than a textbook in providing the opportunity for the learner to override the system. Even systems which incorporate an idiosyncratic adaptive model for each student have been programmed in such a way that learner control is very limited (Merrill, 1984).

Design Interventions

Several design enhancements within a system control approach are supported by research

evidence. Learning has been shown to be most effective when criterion questions are embedded throughout the lesson. As well, questioning and response feedback procedures have been shown to increase comprehension and attention to instruction using interactive video (Hannafin, 1985). Both idiosyncratic adaptive instruction, and instruction utilizing the above design enhancements may be seen as attempts to assist the individual to most successfully achieve desired program goals and objectives. Thus both may be more effective in situations where there is clear agreement on the desirability of all students mastering relatively specific instructional outcomes.

Internal Program Guidance

Research evidence verifies the desirability of including some form of "coaching" to assist learners in making informed decisions (Hannafin, 1984; Ross, 1984; Tennyson and Buttrey, 1980). Successful procedures have been developed in research settings which offer guidance upon which individual student's decisions can be based. The program can advise the learner as to the number and types of practice items or examples recommended, current mastery status, and other performance features. The advisement is based upon the individuals past, current, or cumulative performance during a given lesson. The learner maintains control by being able to accept or reject the offered advice (Hannafin, 1984; Hannafin, 1985).

Guided Learner Control

Merrill (1984) identified several levels of conscious processing over which the learner can exercise deliberate control. The levels, which are briefly described below, represent a framework for analyzing the nature of learner control in a given instructional situation:

Content Control: Present when the learner can select and sequence segments, lessons, or units of instruction.

Display Control: The presentation of a single subject matter idea. A display might consist of

a general statement (a definition; steps in a procedure; a cause and effect proposition) or a specific example (a representation of an object or event; a demonstration; an illustration of a cause-and-effect phenomena). In this sense a display is determined by the subject matter idea, rather than the physical form of presentation of that idea.

Display control consists of providing the student with a mechanism for selecting and sequencing those displays which could contribute to understanding an objective. While display control is obviously facilitated, it "is not limited to computer-based systems, but can easily be implemented through textbooks, workbooks, and other individualized media by isolating and identifying the individual presentation-displays and by encouraging students to select only those displays which they feel they need" (Merrill, 1984, p. 239). The goal would seem to be to make the structure and identification of instructional displays apparent so that retrieval of displays is facilitated.

Conscious Cognition: Refers to the mental processes the student uses to encode the information presented in a given display. It is assumed to exist in every instructional situation, as the learner must decide what to do to encode the material presented. The learner can choose to use whatever mental processing appears to be appropriate for learning a given display.

Meta-Cognition: While engaging in a lesson, learners acquire internal strategies about how to learn, in addition to subject matter. Meta-Cognition refers to the "how to study" model which the student uses to guide interaction with the instructional system being used (Merrill, 1984).

A major thrust of the research by Merrill and associates with adaptive CAI featuring internal learner control involves attempting to guide the learner by providing carefully defined strategy options for controlling display presentation. They suggest that students could be taught more appropriate processing procedures and encouraged to use the strategies (meta-cognitions) where appropriate. In early research, Merrill and associates failed to confirm the hypothesis "Students who are provided directions in how to use display-control will perform better than will students who do not receive such instruction". It was speculated that students are not used to having learner control over individual

displays, and they apparently settle for a rather simple adaptive method of display selection, rather than carefully assessing the need for the next display.

Somewhat more promising were conclusions re: the hypothesis "Students who are provided directions for conscious cognitive processing of the information presented will perform better than will students who are left to their own internal processing strategies". Students who received directions about how to process the information scored higher on the posttest than students who didn't receive the directions.

The potential importance of directed learner control is emphasized by a declaration (Merrill, 1984) that helping students develop internal adaptive models which direct their use of appropriate internal processing is the most promising area for future learner control exploration.

Browsing

A total learner control orientation within an adaptive CAI context merely implies allowing learners to make decisions about what they want to learn by selecting options which are presented at different points in the lesson (Ross, 1984). Recent interest in hypertext and hypermedia has been accompanied by claims and suggestions of even greater user empowerment. Hypertext refers to the electronic representation of text that utilizes the random access capacity of computers to counteract the totally sequential medium of print on paper. Hypermedia incorporates access to graphics, sound, animation and other forms of information. The term hyperdocument has been used to refer to the actual text, lesson, or product (Marchionini, 1988).

Proponents and vendors of hypermedia authoring systems claim that any expert on any subject will be able to produce attractive, accessible, and powerful instructional applications with a moderate investment of time and energy (Morariu, 1988). Learners using hypermedia are freed from the linear tradition of printed text. "They are encouraged to browse a hyperdocument, move easily among vast quantities of information according to plan or serendipity, follow relationships pre-coordinated by the

author or create their own paths through the information" (Marchionini, 1988, p. 8).

However, freedom and empowerment mean that learners, particularly where specific instructional outcomes are an issue, require new strategies and tools for making the best use of their time and effort. The challenge to designers is to devise ways to help learners manage this freedom of learning (Marchionini, 1988). Thus, the importance of careful design and development is no less critical in the design of instructional hypermedia environments than for other learning formats. "In order to successfully use a hypermedia application, learners must be provided with appropriate and clear navigational and conceptual tools in order to explore even the best-designed systems" (Morariu, 1988, p. 19).

Since hypermedia's historical roots relate to information storage and retrieval, many issues concerning hypermedia knowledge bases used for learning persist. A recent review of literature and landmark references identified software capability, knowledge representation, navigation and, authoring discrete information units as key issues and concluded: "A grammar for non-linear information representation and mechanisms for maximizing learning are urgently needed" (Locatis, Letourneau & Banvard, 1989, p. 74).

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CREATIVE PARTICIPATION IN EDUCATION AND DEVELOPMENT -- A WAVE TO CATCH --

Paul MacLeod
C. Anne MacLeod

> In a small village of Ban Soktair in Northeast Thailand, five young school children kneel on the floor around a picture they have drawn of their school fish pond. Carefully they move small cut-out figures of themselves, of fish and of the school dog; one girl sprinkles bits of dirt across one corner. Mounted on a tripod above them stands a 16mm. camera. They all work intensely for several minutes, then lean back as one boy, after checking that everything is ready, presses the button to take two frames of picture. On the last click of the shutter, they lean forward and resume work.
>
> These children are creating an illusion ... bringing their cut-out figures to life through 'animation' to tell the story of their school fishpond so other children can learn about growing fish.

Whether as sophisticated, highly-crafted film art or its mass-produced television hybrid (which cynically offers little more than commercials for plastic-and-soft-toy spin-offs), animation is generally dismissed as too sophisticated or remote to be an effective participatory tool in education or development. This is true even in well-endowed environments. Where resources are scarce, participatory creativity is often sacrificed to ensure minimum application of basic essentials. Alas, all too often 'creative process' somehow does not seem to qualify as essential.

The introduction of computers into education and development work has facilitated exploration of creative expression; unfortunately creativity is frequently assigned a priority much lower than training in market-oriented skills, research, or utilization of learning programmes which, even when they are interactive, are designed by professionals for consumption by others.

In the context of development communication, animation has been seldom used, and then primarily as a production technique for top-down training to demonstrate technical points, explain abstractions, or simply to add appeal to productions.

However, there have been demonstrations of how effective film animation can be as a creative, participatory, integrating tool requiring only modest resources and boundless imagination.

The Thai children working on the library floor in Ban Soktair were one example. They were participants in the CIDA-funded Northeast Fishery Project (NFP) of the Department of Fisheries (DOF) and the Royal Thai Government (1986-90).

The underlying philosophy of the extension component of the NFP was a commitment to the principle of facilitating direct participation of people in their own development. To achieve this, the Project mandate encouraged demonstrating different types and formats of production than were normally made by the extension Division, as well as designing and implementing innovative approaches to utilizing media tools.

It was in this specific context that the children's animation project evolved; however Canadian experience also contributed directly to the evolution of the activity.

Canadian Background

The concept had its roots in work done several years earlier at Vanier Elementary School in St. John's, Newfoundland, where a direct and quite simple approach to introducing children to animation evolved from a collaboration between teachers and a film animator.

Each year, over a 5-year period, the same basic approach was followed, with minor refinements based on accumulating experience. It began with a classroom session in which a variety of animation films were screened and the children were encouraged to examine and handle the types of materials and supplies used in them. Short pieces of an old film were passed around to show that a 'movie' is only a series of still pictures. It was a lively hands-on session that usually elicited many questions and generated a high degree of enthusiasm for the activity.

Between 30 and 40 children from Grade three were involved (in some cases more than one class combined), so preparation for an execution of the under-camera work had to be well organized. Groups of four or five pupils formed teams to design and prepare cut-out artwork (or gather together materials) to shoot. Some years, a class theme was selected, and each group contributed a segment.

Cut-outs were best suited to the half-day available for shooting; so the children were shown how to prepare backgrounds and the cut-out figures that would tell their stories. Although the animation projects usually were identified as part of the art programme, teachers soon discovered that they lent themselves to integration with other subjects.

As artwork evolved, suggestions were made to facilitate the animation, particularly how to extend art to accommodate the aspect ratio of film and where to cut figures to move them more easily.

Project support was offered by Memorial University; a half-day for filming was scheduled at the Media Unit of the Extension Service. On the assigned day three work areas were set aside. In the first room, one or two groups laid out the art work and checked that all the pieces were where they should be; this was their last chance to agree on who would do what activity first, once they entered the animation room.

One group at a time worked under the camera. The children were shown how to adjust the camera to frame their work, what buttons to push to activate the camera, and how to move the cut-outs within the frame. As they shot they rotated responsibilities of camera operation and artwork movement. Each group took between thirty and fifty minutes to complete shooting. it was here that the meticulous planning paid off, and remarkably few (and only minor) problems were even encountered.

After shooting, the groups went to the Media Unit theatre to look at and talk about more animation films while waiting for the other groups to finish. (The first groups joined students still waiting to begin preparation, until the rotation was complete).

Several days later the processed film was returned to the school for screening. Invariably the response was the same: wonder, excitement, and a sense of having accomplished something unique.

A couple of particularly interesting theme projects evolved.

One year a teacher did a Super-8 project with her own class. The result, an animated film about the Battle of the Plains of Abraham, won national recognition for excellence in innovative educational programmes.

Another year was particularly significant in demonstrating the participatory power of animation in the school setting. It was a time of great interest and expectation related to oil development off the coasts of Newfoundland. Teachers suggested that the project look at what the impact of that development might be on the province. The children readily took up the challenge and actively researched the subject, drawing on parents and neighbours as well as their teachers, newspapers and information available on film and television.

The level of enthusiasm for this project was remarkably high and drew attention to the potential for involvement passing far beyond classroom walls. On the day of the premiere of the oil animation, every parent of participating children showed up at the afternoon screening. The animation itself was simple and filled with technical "problems" such as flashing hands, little bumps and a few long pauses. But nobody seemed to notice, perhaps because they were absorbed by and impressed with the depth of understanding of a complex subject that their children had revealed; in fact the video of the film was incorporated into many community screenings then being conducted by the Extension Service of Memorial University, to foster citizen discussion of issues surrounding the offshore oil question.

As well, on that first afternoon, the artwork for the animation was displayed, revealing one more dimension inherent in creative projects of this type.

Thus was laid the groundwork for the comprehensive children's animation experiment in rural Thailand several years later.

Thailand Experience

As the DOF video and animation/graphics trainees explored project ideas, they were particularly attracted to the description of animation work with children. Support of school fish ponds was one facet of their work, and they wondered how village children in Northeast Thailand might respond to the opportunity to create an animated story of their experience.

No one knew if anything like this had been tried before under similar circumstances. Nor were

initial discussions with some Bangkok colleagues encouraging: surely they could not expect children in a poor village in the Northeast to produce anything of artistic value ... let alone animation in a sophisticated medium like film!

However supported by their Deputy Director General, and with the assistance of Fisheries Station biologists and extension workers, they identified Ban Soktair village school as a possibility. The principal, who had developed the school's award winning fish pond programme, welcomed the challenging experiment.

The NFP team followed the pattern that had evolved in Canada. In fact on their first visit to the school, they showed a video of the oil animation film. Although language and content were not familiar, the Thai children easily identified with the simplicity of art created by children their own age.

DOF staff explained the Newfoundland context of the story and showed some of their own first efforts, as well as actual cut-out and clay figures, and cells on which they were working. Pieces of an old film were also handed around. Working with the children provided the fledgling DOF animators with an opportunity to try new ideas, and helped them understand more about the craft of animation as they found ways to explain it.

Conscious of cultural and other differences, the implementing team carefully monitored each step of the process. What impressed them was how similar the responses of Thai children were to those of Canadian. Any differences were primarily of degree: rural Thai children have much less media "exposure" and participate in school activities with greater discipline than do their Canadian counterparts, and this coloured responses and reactions. But it was obvious from the first day that the approach was as "appropriate" in rural Thailand as it had been in Canada.

The art work for the project would be done within the regular art programme. The fish pond story was divided into 14 sections, each assigned to a group of four or five - a total of more than 60 students - most from the 6th year, with a few from the 5th. Each group researched its assigned topic and developed an approach to its part of the story. In only a few periods backgrounds were prepared;

then the cut-out figures began to take shape.

The principal and teachers were delighted to discover that in art classes children were talking about and learning more about fish and their pond. This confirmed the positive integrating power inherent in a project of this nature that had been noted in the Canadian experience. While animation is particularly stimulating and involving, other creative activities such as photography, video production, model building and art offer similar potential. Selection of topics for creative projects from either the school curriculum or from an activity that is part of a school programme can bring a new dimension to overall student development.

The Project covered a span of several months, however the actual time invested by teachers and the DOF team was not that great, and did not intrude into the regular school programme. In each of 5 months the DOF graphics group spent a half-day at the school as the "impossible" project gained a momentum and revealed exciting possibilities that even the most optimistic had not anticipated. Enthusiasm was running very high by Christmas, 1987, as preparations for shooting began.

Obviously the camera set-up in the school library was much less sophisticated than had been the case in the professional studio in Canada. A Bolex camera with a single frame animation motor was suspended from the inverted head of a tripod, above the art work laid out on the floor. One light was focused on the picture from the top. [1]

Sitting on the floor, each group of children worked patiently for two or three hours. They began by positioning their cut-out figures in starting positions on the background and running off four or five seconds with no movement. Then with explanations from a DOF animator they started to move all the figures half the width of their little finger at a time. For several minutes they worded in total absorption until everything was ready; then they sat back as the one responsible for taking the pictures made certain that hands, cutters and many other tools were out of the way before pressing the button to take "frames". Then they all resumed their positions over the art-work to move their figures a little bit more.

As one group worked under the camera, another prepared its art-work: some arms and legs

had to be cut off bodies of figures so they could be moved separately; in one case the outline of the top of a tree painted at the front of a pond was cut from the background so it could be lifted to allow fish to appear to swim in the pond rather than over the top of the tree!

It took six days for all 14 groups to finish the story. In the process they had learned a little bit about animation movement and timing and film ... and a great deal more about growing fish.

The processed film was transferred to video and edited. Aside from an animated DOF logo and title at the beginning, and shots at the end showing the children working on their animation, the visuals in the seven minute video were entirely the children's. Sound effects and a narration read by a 14-year-old schoolgirl were added.

On the day of the school premiere, the TV was set up in an open-sided pavilion as half of the school's 200 students excitedly waited. As the show began there was silence, but as the images rushed by, the response steadily grew. The bulldozer scooping out the pond was especially popular; so was the dog who ran and barked as "cut-out" students placed fingerlings in the pond and the way "visitors" emerged from vehicles as if from spaceships brought laughter from 100 throats.

In only seven minutes it was over! The whole story was there but the overwhelming reaction was: "we want to see more." So it was shown again ... and yet again. Each time something new was noticed and pointed out to friends. Another tape was shown, this one of children from a neighbouring province who had developed a dance about growing fish in the rice-field. It too was shown three times as students danced along. It was time for the second half of the school to have its turn – with the same delighted response and even greater participation.

It was an afternoon of "cartoons", music and dancing, and fun and laughter – all centred around the theme of growing fish! It was also an afternoon filled with a tangible sense of accomplishment and justifiable pride.

The artwork was of very high quality, so the cut-out figures were glued into place and the works framed; the resulting fourteen piece art exhibit was available for use in conferences, for teacher training,

and in villages and at exhibitions and fairs.

Appropriately, the very first exhibition and screening was held one evening in the village of Ban Soktair for parents and friends of the children. Over 400 filled the meeting place in the wat (temple) to watch the video on 3 monitors. The art exhibit hung around the walls and before the screening children led parents and grandparents, aunts and uncles, brothers and sisters from picture to picture, pausing an extra time in front of their "special" picture to show the work that they had done. It was an emotional evening for the Canadians and their Thai counterparts ... perhaps the warmest highlight of their experience together.

In the weeks that followed the video was shown in schools and with adult audiences throughout the Northeast; always the response was positive.

The work that had been done had strong appeal to the Thai division of UNICEF, and work began to convert the art into a combination calendar and flip-chart for teachers to use in schools. In addition plans were made to make black and white versions of the art into a colouring book.

But what most attracted the Director of the Thai UNICEF programme was the methodology that had made it possible for the children to create the art and the animation, and was eager for teachers throughout the country to become aware of it. For her the important "wave" was not the technology or the product; these were but the manifestations. The wave to be caught was the "process" with its almost boundless potential for participation and involvement which she identified as the heart and soul of both development and education.

"Participation" and Development Work With Children

The importance of winning the minds and hearts of children has not been overlooked by those creating movements whose objective is absolute domination. There are many examples of regimes which have recognized the importance of capturing the support of the very young, and have done so with such frightening efficiency that it has been the very young who have spearheaded some of their

most vicious and destructive campaigns. [2]

Ironically the potential of involving children in positive and constructive "development" seems to be poorly, if at all, understood. "Children" as a group are often "targeted" (especially by projects related to health); but too seldom are they actively and creatively involved directly in actual implementation. Often their only "participation" appears to be as passive recipients.

Much the same may be said of many education environments. Of course it could be legitimately argued that through frequently endorsed, the concept of participation itself is seldom employed in development practice, even a decade after the World Conference on Agrarian Reform and Rural Development (1979) declared:

> Rural development strategies can realize their full potential only through the motivation, active involvement and organization at the grass-roots level of rural people, with special emphasis on the least advantaged, in conceptualizing and designing policies and programmes ... (emphasis added)

Terms such as "interaction" and "participation" proliferate in planning and project documents; yet few funding agencies and fewer implementing organizations appreciate the implications for time and investment required. Consequently when overly optimistic project "plans" are reviewed in the harsh light of project implementation and budget realities, interpretations of "citizen involvement" emerge that "citizens" themselves would be hard pressed to identify as having truly "involved" them.

Most project management professionals have backgrounds that do little to prepare them for "interaction" or "participation", and they often demonstrate little patience with concepts that threaten to delay "getting on with the job." Nor is lack of understanding limited to "experts" and "planners" from donor countries; resistance to participation is often deeply entrenched in the elites who form governments and bureaucracies of recipient countries.

In addition, "macro" objectives often obscure the potential that resides in "micro" components, which can provide an ideal environment for experimentation with appropriate methodologies and the development and testing of materials destined for use with those "communities" that will participate in

the development project(s).

Educators concerned about the implementation of creative programming might find parallels in their field.

Thus potentially significant creative tools for effective, participatory development work (perhaps the best possible investment in the future of both education and development) are often largely ignored.[3]

Catch the Wave or "Wipe Out"?

Evolving computer technology presents creative opportunities that could not be imagined even three years ago. We can expect the pace to accelerate even more in the next few years. Computer platforms such as the Amiga provide an environment for astounding graphics and animation at remarkably low cost. Animation on film continues to be viable in many situations, and the proliferation of camcorders opens still more doors. At the same time it is critical to emphasize that creativity need not be tied to technology. Traditional art programmes -- even those that may be underfunded and have very limited resources -- can become highly involving and relevant if they are directly integrated into school or community issues and activities.

Certainly in the development field, and possibly in education as well, it is essential that commitment go beyond mere lip-service to encompass active support at all levels, from government and agency funding through multiple layers of bureaucracies to dedicated teachers and development workers (both government and NGO) working in schools and villages throughout the world.

If it is accepted that creative "participation" is a wave of significance, does the will exist to catch it, or will development and education bureaucracies "wipe out" and miss the opportunity?

Everyone who catches the excitement generated by this type of learning process must make sure that the wave is not lost, but is ridden with innovation, enthusiasm and courage. The risks no doubt are high, but pale to insignificance when compared with the benefits and rewards that flow from

successful implementation of a creative programme based on true participation.

Footnotes

1. Consideration had been given to shooting outside, using the sun for light, however since electricity was available and the library provided protection from wind and dirt, the group chose to work indoors. Although a single-frame electric motor was used, in situations where there is no electricity, an outside set-up and use of a wind-up or battery motor on the camera would produce satisfactory results.

2. For example, in neighbouring Cambodia, the Khmer Rouge were particularly effective in using children to implement their terror.

3. Obviously there are notable exceptions, however, they are relatively few. In Thailand in the Tung Kula Ronghai Project funded by the Australian Government work with school children has been emphasized. The work included use of dance and other forms of cultural expression to promote fisheries development. Also a preliminary effort was made to combine Canadian and Australian resources to experiment with designing board games to help teach children about growing fish.

ADAPTATION AND COLLABORATION: A NEW FUTURE FOR EDUCATIONAL TECHNOLOGY

David A. Mappin
Sharon I. Jamieson

Now is the winter of our discontent
Made glorious summer by this sun of York...

William Shakespeare
Richard III Act I, Sc i

In the focus papers for this conference Beckwith (1988) and Mitchell (1989) have both expressed discontent with the current state of educational technology. This is not limited to Beckwith and Mitchell. Discontent with the established practices of educational technology have been emerging for the past decade. At first it was only the nagging questions about research paradigms and results raised by people like Salomon and Clark (1977), Salomon (1979), and Clark (1983). Then it became a more general trend, variously described, then summarized and highlighted by writers such as Heinich (1984); Beckwith (1988) and Mitchell (1989). Now it has become a flood. The past months have seen a spate of articles declaiming the lack of utility of established instructional design procedures for designing interactive learning systems (e.g. Lange & Grovdahl, 1989; Buckley, 1990; Merrill, Li, & Jones, 1990a; Merrill, et al. 1990b;) and articles generally acknowledging the field to be in disarray. We do not agree with the bleak future for educational technology forecast by Mitchell while attempting to present the case for its demise. We would suggest that what was advertised as a eulogy was more an exercise in semantic realignment.

Those of us who work in areas of the social sciences, particularly those related to postsecondary education, are not surprised to see the discontent surface. We have for a long time chafed under reductionist instructional design procedures. These procedures required the breakdown of complex ideas into measurable educational, if not behavioural, objectives. The complex ideas of

interest in our milieu were most often highly context dependent and reliant on the established skills, background knowledge, and belief/value systems of the students dealing with them. It was easy to lose the relevance of the whole in reducing them to objective sized components.

We did our best with these procedures and wondered why colleagues with whom we worked bridled at them when the ends were so desirable. After all, who could argue against improved learner involvement and performance in shorter time? However, these procedural structures had no apparent utility to our non-technical colleagues. As Beckwith (1988) asserts, in trying to make them work, we 'compromised our integrity' (p. 8) with our silent acceptance of many of the dictums of behaviourist psychology, and in other ways. We 'adhered to the status quo' (p. 10) by humanly craving the legitimacy granted other professions, and in other ways. We acceded to 'solidification' (p. 13) through the use of fixed sequences and procedures, the establishment of rules, and in other ways, to try to communicate with others the power and potential we saw in educational technology. Perhaps, subconsciously we were trying to use 'solidification' to obtain the power to make the dream of educational technology a reality. We have left pieces of our 'pride' in all of these traps, but we are not close to death. We would suggest that what Beckwith, Mitchell, and many other writers describe is only a stage of paradigmatic development according to Kuhn (1962), the educational technology version of a reconsideration within all of education in the past decade. We see it has a healthy evolution. Part of that evolution involves a need to develop more adaptive instructional design procedures that can bridge the gap between the instructional designer and the curriculum/content specialist, at the same time easing work with the newer technologies.

Post-secondary institutions provide a rich ground for theory to practice adaptation. As practitioners operating in a highly theoretical environment, we are required to work in partnership with curriculum/content specialists and to adapt where necessary. To survive we have been required to change those instructional design procedures which didn't work and seek new ones. Beckwith and Mitchell might call this political expediency or absorption or in some cases innovation affiliation. We

would call it a case of practice leading theory. We have selected from a variety of theoretical constructs, choosing intuitively in the first instance those which made common sense, but recognizing that our intuitive choices must be cast into theoretical generalizations before we can have an impact on the field and the work of our colleagues. We are still at a point of considerable discontent, in possession of knowledge of specific applications in specific circumstances for the development of learning without the generalizable principles to put before our colleagues for testing, critique and application. But always behind our adaptation has been the long view, the goal of having teacher education deal more with what learners do and less with what teachers do. It will be awhile yet.

In the remainder of this paper we will describe one project example in which we are using techniques which might be called systemic design. In part, our message is about the process synergy and the products which emerged from a collaboration in which instructors in the history of teacher education, discontented with teaching sets of dates, facts, and static lists of reasons, challenged discontented instructional technologists to set aside their reductionist procedure manuals and pursue a new way to teach process skills to undergraduate students. These process skills included those used by practicing historians and skills of critical thinking. We will describe the shift to a process learning approach, student considerations, the processes of historical inquiry, critical thinking, the evolving instructional approach, and some instructional design factors.

Learning From A Process Approach

The teaching of educational history has been a dying subject area in teacher education programs in the past decade. Much of its demise can be attributed to the lack of student interest and enthusiasm in the topic as well as the perceived irrelevance of the topic to the development of skills that would be useful to a teacher. Our beginning pedagogic premise was that the teaching of history should involve the student in as direct access to the historical event as possible. Rather than a textbook interpretation of historical events we wished to expose the student to historical documents (the

primary sources) and lead them through exercises that would have them derive their own interpretation of the event. Rather than have them memorize dates and facts we were asking them to develop skills in accessing, assessing and making judgments regarding the historical documents presented to them. The underlying assumption was that through the process of critical inquiry the student would develop intellectual skills or thinking skills that would enhance their ability across courses and subject areas. There would be a transfer of skills to other subjects or endeavours. We also hoped to instill in the students some of the excitement and mystery that occurs in the process of historical inquiry.

The initial instructional process was instructor and materials intensive. While developing the collection of historical documents a number of problems related to storage and access emerged. As the collection expanded we began to realize that students would be buried in masses of information unless some way was found to manage both the information and the instructional strategies.

To address these issues two primary technological thrusts were incorporated into the project. The first of these was to put the collection in a form which could be easily accessed by researchers, and by students with little fear of misfiling, loss or damage to the 15,000 photographic images and the important documents. The second thrust was to undertake the exploration of an individualized system of instruction which could help students learn historical process skills without the direct intervention of an instructor for a substantial portion of the students' work.

As it turned out the solutions chosen by the team for both of these thrusts relied greatly on computer based interactive video systems. The emphasis in this paper is on the development of the individualized system of instruction.

Student Considerations

Another aspect fundamental to any instructional design undertaking is the learner. In addition to the more usual concerns for students in instructional design practice, the hope in undertaking this project was that each individual could bring their own personality, knowledge, interests, and beliefs to

the learning task and have them recognized. However, in acknowledging that there is individuality in each student, there is also an unwillingness to accept that undergraduate students are completely developed in their intellectual and ethical capacities. The team has looked as the developmental theories of William Perry (1970) in this area and found much which had a good deal of resonance for us.

Perry describes nine levels of development of students, which are most often summarized into three or four categories (e.g. Perry, 1970; Stonewater, Stonewater, & B. Perry, 1988; Kurfiss, 1988). These categories are *dualism, multiplicity, relativism,* and *committment to relativism.* In the dualism category students are described as seeing the world in black/white, right/wrong terms. Perry suggests it is desirable, and natural, for their development to progress from dualism through the other stages. In doing so they begin to allow for more than one right answer and gradually, evolve into committment to a world view in which there are multiple, context dependent points of view, which can be supported by evidence and logic. Perry's theories seemed to match the desired evolution of process skills in our project and we have been working with them. We hope they will provide both assistance in understanding students reaction to the instructional environment, and possibly a way of assessing them in order to place them into the instructional environment at a more individually suitable place.

The Processes of Historical Inquiry

Generally historical inquiry proceeds through the following stages:

1. Choosing a question for investigation.
2. Seeking information in the broadest possible way.
3. Sorting and categorizing the information to establish evidence.
4. Establishing the context in which the events took place.
5. Exploring interpretations of the evidence and context.

6. Establishing a synthesis of the evidence and context.

In all of these stages the processes of analyzing what is found, reasoning about it, and forming judgments about the information and concepts are essential parts of the process. The unchallenging or unreflective acceptance of an historical synthesis from a secondary source by any student is seen to be undesirable.

The process approach to historical investigation and critical thinking was intended to free all individuals to make their own interpretations of historical materials, and to evaluate the accounts of historians and other writers and documenters who have gone before. This is not to say that fallacious logic, strongly held beliefs, or any of numerous other factors may not cause those students to create personal understandings which could be blatantly open to question by even the least knowledgable person.

Each of the stages of the historical process is further refined into sub-categories. For example, in describing the process of information seeking Furey and Salevouris (1979) make reference to six groups of "starter questions" (p. 43):

> (1) the influence of individuals; (2) the influence of organizations (groups, factions, nations, etc.); (3) the influence of institutions; (4) the influence of ideas; (5) the influence of economic and technological factors; and (6) the influence of the physical and biological environment. (p. 43)

Each of these in turn may be sub-divided, and in considering them as evidence other problems emerge. Such problems have been described, again using Furey and Salevouris as an example, as four "filters" (p. 59) which limit and affect the information available. These are the readily recognizable filters of limited observation, limited memory, limited recording of events, and limited credibility of the recorder

(p.59). These are further distorted through the opinions and prejudices of the historian conducting the investigation.

It would be possible to go on listing and presenting a detailed approach to the way in which historians see the process of doing history but it would serve little purpose. This overview and the examples presented serve to illustrate that lectures which require students to take down and subsequently recall dates and other peoples interpretations of events are not seen to develop the skills historians would like to see university students acquire. The obvious alternative suggested above is to make students better able to critically read historical accounts, and events of today, having developed an understanding of the detailed processes involved and established an understanding of their own beliefs and values which would influence their interpretation.

Some Interesting Additions From Critical Thinking

Not surprisingly, much of the literature on teaching critical thinking describes processes which are analogous to the processes of history. This literature has contributed interesting dimensions to the design of the lessons on which the team has been working, and we anticipate it will continue to do so.

Ideas of problem definition, information gathering, careful analysis and judging of that information, and creatively reasoning to a conclusion are central to most areas of academic endeavour and as such bring little to our project. Some ideas affiliated to these basic descriptions of process, however, add considerably more. Three examples should serve to make the point. We have found that some of the critical thinking work which discusses a tolerance of ambiguity, the role of metacognition, and the detailed descriptions of evaluating skills to make interesting contributions.

In describing the characteristics of a "good thinker" Glatthorn and Baron (1985), among others, included the idea of tolerance of ambiguity. This idea called to mind several examples of student behaviour in class situations, and we found it related to parallel reading we were doing with regard to William Perry's work on the intellectual and ethical development of college students. One of our goals

is to have students cope with the understanding that answers presented by historians might not be right, or wrong, or that they might differ greatly from one another. This is seen to be increasingly important given the multiple viewpoints of different groups being promulgated in society today.

Other writing in this area deals with the role that metacognition could play in helping learners evolve their thinking skills. Again this was not a unique discovery, but one which linked and expanded on ideas team members had been previously familiar with from cognitive psychology and some work in instructional design research. Metacognition is generally understood to mean our conscious understanding of our own cognitive processes, and the ways in which we can use these processes to enhance our learning. In the critical thinking literature for example, Pressiesen (1985) has described how metacognition might be used to both monitor performance and improve it through strategic consideration of differing approaches (p. 46). It became a goal of the project team to attempt to incorporate the development and use of metacognitive strategies by students.

We also found descriptions of evaluating skills in critical thinking literature. While many of these were aimed at identifying the evaluation skills students needed to possess in critically looking at the work of others, they also provided ways of looking at student performance. This second analysis has been helpful to us in seeking the form that computerized evaluations of student efforts might take (e.g. Langrehr, 1988, pp. 82-104).

The Evolving Instructional Approach

The idea we are working with might be called the spiral of release. It is founded in the idea that we can teach the processes we are interested in by using a limited set of information and data. As the instructional series proceeds each lesson brings in more factors and more information to be considered. After a certain number of lessons the processes have all been outlined and practised, but the amount of information which should be dealt with, the information in the libraries, data bases, and attics of the world, cannot be contained within the boundaries of our technology, so the student is directed into the

real world of information for the next assignments.

Along with the increasing complexity of the processes and the complexity and volume of information comes an increase in ambiguity. It is our hope that the sequence of instruction will also be able to help students leave behind a world of black and white, moving into a world with many shades of grey. We hope to help them in acquiring the skills to cope with that ambiguity. The process is intended to be one of guided discovery, using ideas developed from Bruner (1966). More recently these ideas have been rediscovered and promoted (e.g. Brown, 1983; Wilson, 1988) as interactive computer-based learning and multi-media environments become more sophisticated.

To coordinate, search and present the information a sophisticated database program, Arity/Prolog, has been used in an IBM Infowindow environment, with a good deal of custom programming to provide the links to the videodisc machine, graphics, and touchscreen capability. As this implies, the student interface can be via the keyboard, or via a touchscreen used in combination with the keyboard. Our computer-based system may contain newspaper articles, textbook materials, government documents, correspondence, interpretation, and such other materials as are seen to be important. Photographs and film clips are made available via videodisc at this time, but this may change as new storage and presentation technologies are developed.

Some information about process is provided via tutorials to enable the students to work with a simulation/game to get into the learning environment. One early lesson provides an example here. In a manner similar to an adventure game the student becomes an assistant to a Deputy Minister of Education in Alberta in 1939. The assistant is asked to investigate a charge which arose during the Calgary municipal election of 1939, when it was alleged that a Grade Nine textbook, *The World of Today*, approved by the Department of Education, was riddled with Nazi propaganda. The minister gives one week to accomplish the task.

As the students begin to work with the problem they discovery that they have a peer mentor, Nathan, who is established via video and who interacts with them both 'in person' and through memos.

They can attempt to interview all of the main players in the drama. Some turn out to be available, and some do not. These 'interviews' are really short video presentations from actors.

Print data is available in the form of the textbook, and all of the newspaper articles published in Alberta papers with reference to the occurrence.

Students can choose which of these pieces of information, if any, they would like to consult. The electronic information can be electronically 'clipped' and copies of the information stored in their own files as they think through the problem in an attempt to develop the solution they would like to present to the minister. If they attempt to develop a solution without consulting a substantial number of information sources, Nathan coaches them about the probable negative response of the Deputy, and encourages them to explore the material further.

Although the number of information sources and interviews may seem quite large, this problem was actually chosen because, while real, the amount of historical information existing with regard to it is quite small. It does provide solid links to topics with regard to Progressive Education in following lessons, lessons which shade from an adventure game into historical inquiry.

The largest problem the team still faces relates to evaluation. The task of undertaking a system to parse open ended, constructed responses in a historical data base is a daunting one which we have not yet undertaken. Whether done as an expert system, or in some other fashion, the problems of encouraging solid personal interpretations of history for all individual students without the imposition of a set interpretation by the system designers is a very real one. Romiszowski and Grabowski (1989) have commented on this problem with regard to a business simulation, and it has been considered in relation to an educational administration simulation as well (Mappin, McIntosh, & Maynes, 1989).

To date we have established the computer's ability to track students' progress through the materials and to accumulate information on the number and type of resources consulted by the students. They are encouraged to accumulate 'electronic clippings' in their own file and to write notes and comments on the process in their own text editor file. Other approaches to evaluation and

feedback, such as structural communications (Egan, 1976; Romiszowski, 1989) are also being examined.

Instructional Development/Instructional Design Factors

From the point of view of instructional technology this was another project where it did not make sense to try to use the linear form and terminology of the traditional instructional design models. Given the humanities/social science perspective of the instructors involved, much greater progress could be made by keeping the process transparent and essentially non-linear.

To say the process was kept transparent is to say that we did not overtly attempt to lead the team through the standard steps of an instructional design model which was shown them as the process being undertaken. While documentation was maintained and reference was made to several models as we tried to understand and describe the process for ourselves, team meetings would focus on a topic and deal with it in language more slanted towards history than towards instructional design or computer/videodisc technology. Such topics included the establishment of objectives (non-behavioural); the nature of the student results (acceptable performance measures); the nature of the historical inquiry process; the validity of the representations being proposed; the review of scripts and segment samples; and many others. The climate was far more one of art, craft and metaphor, than one of science. We attribute this to our perception of a lack of an applicable scientific basis for reasoning and interpreting based on historical materials, and to our attempt to develop approaches to metacognition which would help students improve their understanding of what they were doing, and consequently, their performance.

Working in such an environment demands that an instructional designer work back and forth between principles of psychology and sociology which seem to have a solid base in research and the more intuitive development of approaches which seem to offer a good deal of promise. For example, all of the structuring of the simulation environment and the fit of the student within that environment was based on work in simulations and in message design for student achievement (e.g. Fleming and Levie,

1978). The language of the discussions had to be carefully controlled to extend the understanding of the team with regard to the technological possibilities rather than confounding them. This required a process, as noted earlier which led to disregarding formal adherence to the instructional design procedures in a set sequence and adopting an approach which dealt more with all of the topics in an instructional design model in a sequence which made sense to the non-technology oriented team members. This was especially important as the capabilities of interactive computerized learning environments were revealed and concepts related to them built. This procedure also led us to adopt a process which is becoming known as 'rapid prototyping'.

We came to this idea of rapid prototyping as we found that descriptions of interactive computer searches, data manipulations, and visual presentations using oral skills with static drawings did not often convey the necessary concepts to non-technologically oriented team members. To surmount this difficulty we began by establishing a first-draft of a lesson-map for what we thought might be the second interactive lesson in the series. With the help of our computer programmer we quickly mocked up some graphic screens, linked in some unrelated video from available discs, and established elements of the total work environment.

When presented to the team this approach proved so successful that we expanded our use of it. We had already established much of the technological environment which would be used so wherever possible the prototype examples were done with the same programming tools which would be used to complete the project. In this fashion we continued to build on this lesson while both expanding the teams knowledge of how it might work and developing a feel for the student environment.

Our success in working on this project with a more transparent, heuristic approach to the principles of instructional design coupled with explorations of rapid prototyping have been successful enough that we have incorporated them into other development projects for interactive materials and plan to extend them to future projects. There is no implication here that the scientific basis for the

design, production, and implementation of learning materials has nothing to offer. On the contrary. However, we have developed to a position of believing that there are many aspects of the instructional design/development process which need to be undertaken differently given our evolving understanding of the ways to design for and use the newer technologies. Developing a deeper understanding of these processes may need to rely on the newer 'qualitative' approaches to research which are beginning to characterize all of education, than those traditionally imported from rationalistic science (see for example, Guba & Lincoln, 1982; Reeves, 1986; Neuman, 1989).

Directions and Conclusions

This project continues with its development efforts. The Fall of 1990 will see a field test of the materials described in this paper. Armed with the reactions of the students we will adapt our approach and pursue our goal of a more effective way to teach historical processes and critical thinking skills. We will continue to adapt the existing theories of instructional design/development to our purpose. We will continue to seek theories, descriptions, and research of all types which informs this process. We will continue with our own efforts to create models and theories which may at some future date be useful to others in the field.

The central theme of this conference and this collection of papers relates to the idea of a third educational technology. Mitchell has somewhat pessimistically declared our future to be past if we don't refocus dramatically, probably in some way emphasizing cybernetics. Heinich and Beckwith have said similar things without emphasizing cybernetics, and with more optimism for the future of something called educational technology. Is our future to be systematic, or systemic? Must it be one or the other, or might it incorporate elements of both?

We made the point earlier that there have been paradigm shifts in all areas of education in the past decade. It shouldn't surprise us that a profession which has been telling others in education that the pace of social, economic, and technological change will require them to be adaptive should find that

it must itself alter its bases and its goals.

The proliferation and ubiquitous presence of communications and information technology in all areas of our personal and professional lives, assures there will continue to be individuals who will explore its relation to teaching and learning for training and education. The rapidity of that change will assure that those people will be regularly exploring and adapting their philosophical and theoretical bases. Will those explorations and the subsequent applications continue to be called educational technology?

We would suggest it doesn't matter. What ever the field is called, the suggestion that it should be more holistic and adaptive is an interesting one. It is this approach which turned the discontent, that is, the intellectual restlessness and the search for improvement on the part of two groups at our institution, into the "glorious summer" of a fascinating project with some hope of modest changes in teacher education practice.

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COMPUTER BASED LEARNING MATERIALS AS A MEANS TO IMPROVING STUDENT ACHIEVEMENT THROUGH DISTANCE LEARNING

George A.B. Moore
Kreuvrul Sophasan

The Characteristics of Distance Education

There is no longer any question about the fact of distance education. It has become a pervasive force in industrialized and developing nations. Its growth from Isaac Pitman's shorthand tuition by mail 150 years ago to today's long list of institutions committed to distance education is a history still being made. The success of Britain's Open University in the span of two decades (Keegan 1986) has provided both a model and encouragement to other countries, institutions and educators. Canada has been a long time player in this arena.

Just over 100 years ago (1889) Queen's University began to offer credit correspondence courses in the Faculty of Arts and Science (Mugridge and Kaufman, 1986). In 1914 the University of Saskatchewan used "The Better Farming Train" as a means of providing agricultural extension education to farmers and their families living on remote homesteads (Blackburn, 1984). Other notable Canadian pioneering efforts to educate people outside the formal classroom included the Antigonish Movement of St. Francis Xavier University (1927), the National Farm Radio Forum (1941), the National Film Board's Challenge for Change Programme (1967) and Quebec's TEVEC (1968) program in social awareness and high school upgrading for adults in the Lac St. Jean region. Diplomas in Horticulture (1960) and Agriculture (1978) by Independent Study at Guelph, T.V. College at Wilfred Laurier University, courses by audio cassette at Waterloo (1968) and full blown distance education institutions such as Teleuniversite, Athabasca University and the Open Learning Authority (B.C.) provide testimony to the range of opportunities and the demand for distance education in modern society.

The Canadian experience finds counterparts in Australia, China, Hong Kong, India, Indonesia, Jordan, Malaysia, Netherlands, New Zealand, Pakistan, South Africa, Sri Lanka, Thailand, United States

and West Germany. It is noteworthy to recognize the role that contemporary media of the day played in these various settings.

Distance education is found in unimodel institutions created solely for the purpose and which do not have as a rule any students on campus. Another approach is found in traditional institutions which offer classroom bound instruction. In an increasing number of these colleges and universities both classroom instruction and distance education co-exist to create a dual mode of educational opportunity. At Guelph a growing number of spring semester courses are taking a distance education format enabling in-program students to work away from campus in summer but continue their studies at the same time.

The Delivery of Distance Education Learning Opportunities

Distance education in either dual mode or unimode institutions is characterized by a separation of student from teacher for most, if not all of the instructional activity. This communication gap is filled by some form of technical media. The oldest and most pervasive medium in distance education is the printed text and course manual. Some institutions have concentrated their efforts largely on one medium such as the Chinese Central Broadcasting University. The decade of the sixties in Canada and the U.S.A. was filled with a number of examples of broadcast media for formal course credit, such as the Chicago City T.V. College, Cours Interuniversitaire Radiodiffuse and Telediffuse (Quebec), Sir George Williams University (Concordia) and Ryerson's Open College to name but a few examples. While Britain's Open University was announced to the British public by Harold Wilson as the University of the Air, today television accounts for only about ten percent of a student's study time (Heap, 1988). In part the demise of television as the central medium of communication came about as it lost its mystique and we acknowledged again that education is not just the transmission of information but the active interaction with that material by the student to create new associations for her or himself. Today print exists as the major vehicle for distance teaching (Keegan, 1986).

Notwithstanding the prominence of print in distance teaching a number of institutions are developing a framework for course delivery which has within it opportunities for other media to function as components in a multi-media delivery system. In New York Connect Ed uses the EIES computer conferencing system to offer on-line courses to students throughout the U.S., Columbia, Japan and Singapore (Paulsen, 1987). At the Ontario Institute for Studies in Education several graduate courses are regularly offered to teachers from various parts of the province (Harasim, 1986; Davie, 1987) using the PARTICIPATE conferencing system. In Norway the Datahogskolen used EKKO to give a course in computers and data processing to 96 students in the fall of 1986 (Paulsen, 1987). Perhaps the largest use of computer conferencing to date has been the use of CoSy* by Britain's Open University (OU) in a course with 1500 students enroled in Technology and Social Science. The OU's existing course format includes text, television and tutorial groups. The CoSy conferencing application provided on-line computer conferencing for 6 of the assigned 14 hours of tutorial time (Heap, 1988).

Thailand's Sukhothai Thammathirat Open University (STOU) has developed a multi-media instructional system for its course development and delivery. STOU courses are developed by course teams comprising of several academic subject specialists, an educational technologist and an evaluation specialist. The instructional staff is modest by conventional standards. In 1989 there are 984 permanent academic staff, 1344 administrative/support staff and approximately 3600 part-time staff recruited annually from local institutions to serve as tutors and examiners. A network of regional and local study centres and STOU library corners in every provincial public library provide students the opportunity to come together for counselling, tutorial sessions and make use of library reference materials. The distance teaching system of STOU is illustrated in Figure 1. The use of computer based

*CoSy is a computer conferencing system developed at the University of Guelph and available world wide.

learning materials as an "electronic tutor" within the delivery system was first considered in 1985 and will be described later in the paper.

The Promise of Computer Based Learning

Among the first recorded attempts at automating instruction was Sidney Pressey's teaching machine in the early years of the century. This mechanical device presented multiple choice questions to the student and kept track of correct and incorrect responses (Herrmann, 1988). Where Pressey's machine proceeded in linear fashion to teach students, Crowder introduced the concept of branching as a way of taking into account the individual differences among students (Moore, 1989). In the mid 50s, B.F. Skinner provided the theoretical framework for this activity and systematically demonstrated the improvement in student learning of factual information. This provided the basis for much of the mid-century's attention to programmed instruction. However, the scheme was time consuming in the construction of teaching materials and frequently dull for the learner.

With the arrival of the microcomputer, as an outcome of the micro-chip revolution, attention shifted from programmed instruction to computer assisted instruction. The most prominent of the early CAI systems was PLATO developed at the University of Illinois (Heinich et al. 1982). The fascination with the potential of instructional technology has frequently led to its pursuit as the "best", "most effective" or "most efficient" approach.

While the media approach to instruction was following one new technical device after another, a group of learning psychologists led by Fred Keller were developing an instructional approach along other lines at the University of Brazilia (Keller, 1968). The system called by Keller the Personalized System of Instruction or PSI (also known as the Keller Plan) makes no direct use of electronic media but is rather a structured text based scheme which includes carefully stated learning objectives, the concept of mastery of the material to be learned and the demonstration of that mastery through

FIGURE 1

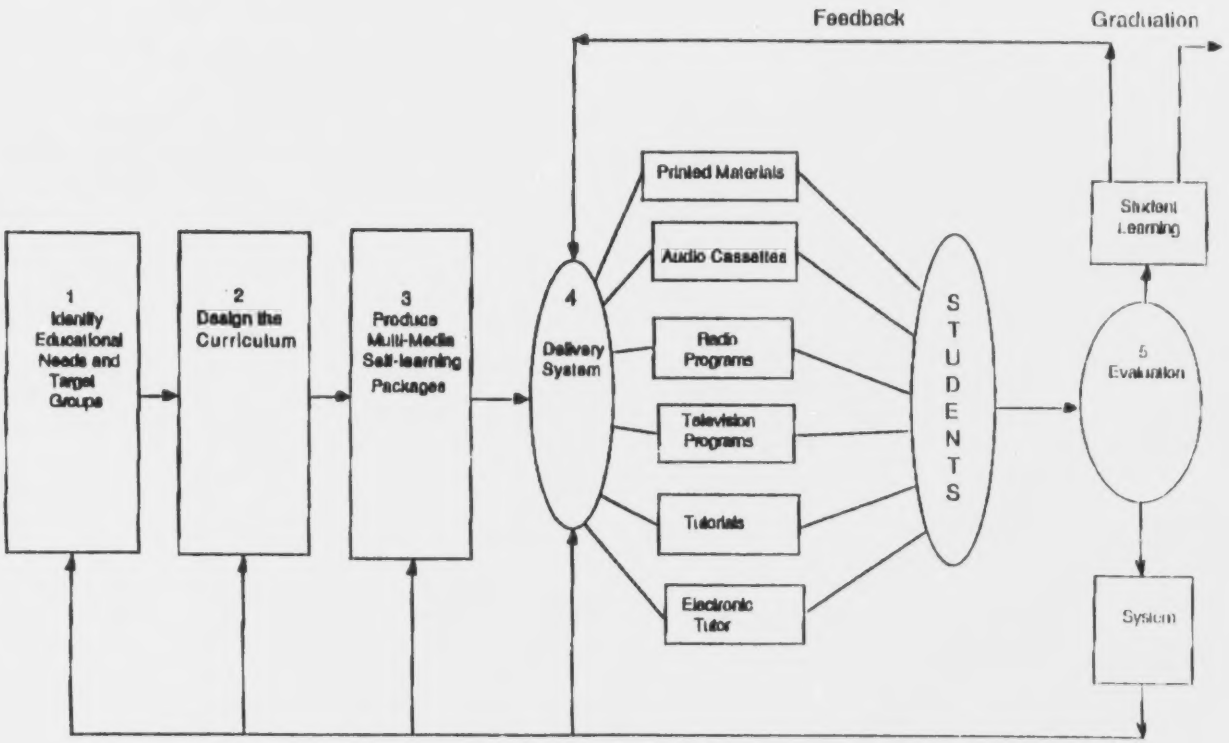

Figure 1: "STOU PLAN" Distance Teaching System

Adapted from Wichit Srisa-an (1984)

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frequent testing followed by immediate feedback. PSI is frequently reported as showing superior performance, as measured by examinations, with consistent reports of results being improved by one letter grade or ten per cent (Leppman and Herrmann 1982, Sakyi and Moore, 1990).

PSI has been widely used in a range of academic disciplines. McKeachie (1986) after examining a number of instructional innovations concluded that PSI has "probably had more impact upon College teaching in the 1970s than any other innovation". In spite of its demonstrated success in improving performance PSI is fraught with some serious administrative and management problems. It is costly in administrative and financial terms to arrange and sustain the schedule of necessary frequent testing and feedback sessions in conventional institutions let alone distance education.

The success of the PSI approach provided the stimulus for a group at Guelph, beginning in 1983, to explore the potential of the microcomputer as a means to address the administrative and management difficulties associated with PSI. The initial outcome of this exploratory work was the creation of VITAL (Versatile Interactive Teaching and Learning System) as a course authoring tool (Moore, 1986). Subsequent development work and upgrades have produced a more versatile and powerful version, VISION, which has recently been selected by the Ontario Training Corporation as the vehicle for producing compact disc (CD) delivered materials.

The Use of the Microcomputer as an Electronic Tutor

The feasibility of computer assisted instruction as a component within an existing multi-media delivery system for distance education was tested in a pilot project at Sukhothai Thammathirat Open University (STOU), Thailand, over a three-year period beginning in May 1986.

The project was a collective effort between STOU and teh University of Guelph under the terms of an institutional cooperation agreement between the two Universities (Moore, Sophasan and Prescott, 1989). The nature of VITAL/VISION which can operate in either networked or stand-alone environments along with its features of high quality colour graphics and ease of authoring were deemed

advantageous to the conditions for distance education in Thailand.

The pilot project comprised three phases:

1. The development of a Thai version of the authoring system, training of Thai staff and the production of courseware for field testing.

2. A preliminary field-trial to test the system and courseware with a sample population of students in a four-day intensive residential Professional Experience Course.

3. A major field trial in three regional study centres and STOU Headquarters over a four-month period under normal distance education study provisions.

The field trial used three core courses which have large enrolments and in which students were experiencing difficulty in completing the course with satisfactory grades (Moore, Sophasan and Prescott, 1989). These courses were (1) Science and Society; (2) Mathematics for Social Science, and (3) Economic and Business Statistics.

The hypothesis of teh research was that if computer based study materials, which emphasized frequent testing and immediate feedback could be developed and made operational in the context of distance education study centres, at reasonable cost, they would result in improved learner performance and satisfaction.

Achievements, Findings and Implications

The findings of the research and development activities fall into the three phases of the project.

1. The Development of CAI capability in Thailand

The first accomplishment was the modification of the VITAL software to create and display the learning materials in the Thai language. Using the capability the dynamically redefineable character set (DRCS) of NAPLPS the Thai counterparts developed a full set of 96 Thai characters which the Guelph team used to produce the VITAL/Thai version.

Training of nine Thai staff members was achieved in a total of 10 weeks spread over a 30 month period. A VITAL/Thai production unit was established at STOU and over the training period the unit produced 15 study modules of 15 minute duration for each of the three courses selected.

Courseware production equipment was initially loaned by IBM-Thailand until STOU was able to acquire its own PS2 model 50 units. The 45 study modules use a self-study test format in which the course content is sampled for each unit in the course block. Each module took 30-40 minutes study time. Student responses were immediately matched against model answers for the multiple choice questions and feedback was provided immediately as well as an aggregate score presented at the end of the session. Session files recorded the individual student responses for each test item. A representative frame from one of the modules in the Science and Society course is seen in Figure 2 which shows both the type of graphic used and the Thai language.

2. Preliminary Field Trial

The preliminary field trial conducted in July 1987 tested the students' ability to work with these computer based study modules in a context where the microcomputer was something of a novelty. Five modules were selected from the Science and Society course and presented during an intensive workshop as part of the four day Professional Experience Course. Seventy-one students from different fields volunteered to participate in the study (Sophasn and Prescott, 1988). Students were classified into three groups in terms of their previous science background; strong, moderate and minimal or no background. At the conclusion of the workshop students completed a detailed questionnaire designed to elicit information on their experience and attitudes in using this type of computer based material.

Of the 72 students in the workshop, 46 were first time enrollees, while 26 or 37 percent were repeaters. All students showed a substantial increase in learning performance but it was among those with a moderate science background where the greatest gains appeared. In terms of attitude to the use of this approach to distance education, 95 percent of the students favoured the continued and expanded use of this medium. It was also found that the "electronic tutorial" system was relatively easy to use. The Thai investigators concluded that "the use of the course ware created by the VITAL system appears to significantly enhance student interest and performance regardless of students' prior educational background ... (and) as a tutorial aid generally helped students to achieve significantly better learning performance." (Sophasan and Prescott, 1988).

Figure 2

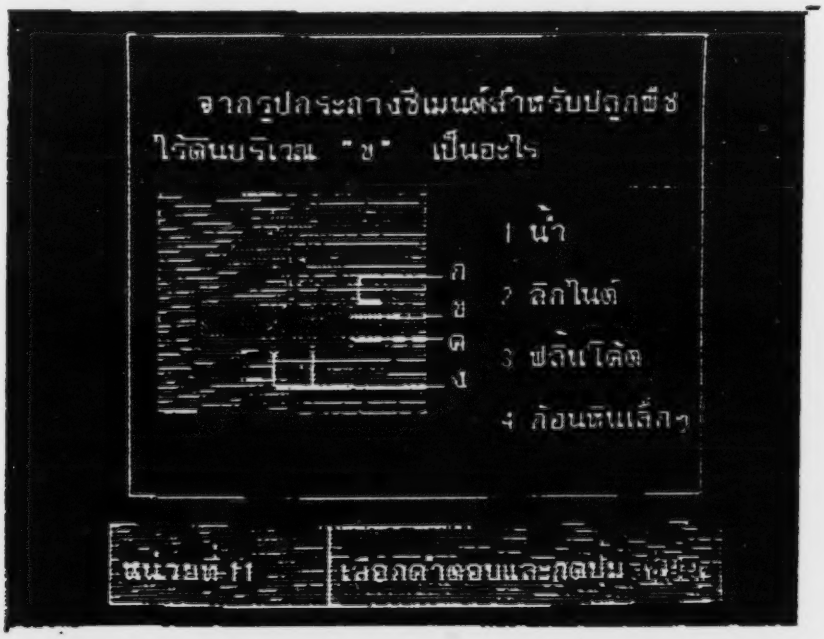

FIGURE 2: AN INSTRUCTIONAL FRAME FROM ONE OF THE MODULES IN THE SCIENCE AND SOCIETY COURSE USING VITAL.

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3. Major Field Trial

The major field trial was held in January to April, 1989 in STOU Headquarters and three regional study centres, two in Chiang Mai and one in Khon Kaen. Each centre was equipped with IBM PS2 model 50 computers on which the 45 modules from the three courses were loaded. Students were encouraged on a voluntary basis to use the study materials for the course in which they were enroled. Seventy students were invited to participate in each of the regional study centres and 210 were invited to the STOU main campus. The participation rate was low with a total of 56 students out of a potential 420 (13.3%) actually using the CAI modules. The students were distributed in the three courses as follows: Science and Society - 25, Mathematics for Social Science - 15 and 16 in Economics and Statistics. Students electing to use the modules were identified as the Treatment Group and their scores on official module tests were compared to the scores of the matching students not using the VITAL/Thai study materials. This latter group served as the control.

In the "Mathematics for Social Science" and the "Economic and Business Statistics" courses only one module out of 15 in each course showed a statistically significant different level of performance between the treatment and control groups on the basis of a T-test.

In the "Science and Society" course the gain in performance in the treatment group was statistically significant at the .05 level. However, the mean gains in all three courses, as shown in Table I, confirm the general findings of PSI research of increased performance in the order of one letter grade or better over conventional instruction (Leppman and Herrmann, 1982).

It will be seen from the data in Table I that the mean scores in the control group represent the normal practice of distance study at STOU, are all below a passing grade. The size of the gain in the Mathematics and Statistics courses while positive is not sufficient to remove the "failing grade" attributed to these courses.

TABLE I: Mean Difference in Performance Scores Between Students Using Computer Based Study Materials for Distance Education and Control

Course	Exp. Group (VITAL/Thai)	Control	Mean Difference	Gain as % of Control
Science & Society	67.43	44.19	23.24	52
Mathematics for Social Science	40.42	32.08	8.34	26
Economics and Business Statistics	56.00	36.33	19.67	59

In the Science and Society Course a closer examination of individual module test results, using a T-test, reveals that while there was a significant gain overall this gain was confined to seven of the 15 modules. The data from these seven modules are shown in Table II.

TABLE II: Mean Differences on Test Scores between Treatment and Control Groups in Seven Modules in the Science and Society Course

Module	Experimental (VITAL/Thai)	Control	Mean Difference	Gain as % of Control
1. The Universe	57.14	38.78	18.36	47
2. The Earth	65.48	48.81	16.67	34
3. Matter & Energy	67.03	38.46	28.57	74
4. Technology in Space, Telecom & Medicine	73.21	50.00	23.21	46
5. Technology in Agriculture Transport and Industry	59.18	34.69	24.49	71
6. Statistics in Daily Life	88.09	57.14	30.95	54
7. Statistics for Decision Making	81.63	53.06	28.57	54

From these data it can be observed that the level of performance in the control group is substantially inferior to that of the treatment group. The mean gain in scores and the percentage gain over the control group substantially exceeds the one letter grade gain associated with PSI in general.

In spite of the learning gains reported in the Science and Society course, the overall level of achievement in all three courses remains something of a serious problem. Additional research and instructional analysis seems warranted to determine levels and areas of difficulty for students in these courses. While the use of computer based learning materials can be directed to areas of difficulty, they cannot of themselves resolve problems of inappropriate content or insufficient attention to instructional design.

Conclusion

The conclusions to be drawn from these findings are that:

1. The transfer of computer based learning technology between institutions in developed and developing countries can be achieved with a minimum of expatriate involvement and time commitment.

2. Students in developing countries can quickly acquire the necessary utilization skills and they show a high degree of satisfaction with the use of computer based learning materials.

3. The hypothesis is accepted that a reasonably priced computer based learning system can be made operational for distance education and that it can result in improved learner performance and satisfaction.

4. Additional research and instructional design effort are required to address the residual problems of student performance in some distance education courses in spite of the positive direction of the learning gains demonstrated.

The research reported here suggests that a stand-alone computer based learning system can contribute to improved student performance in distance education courses. The major contribution which the computer can make is in providing support to the student in terms of frequent intellectual challenges, opportunities for practice and immediate knowledge of results. It is these attributes which are difficult to achieve with conventional distance delivery techniques. The methodology outlined here

sees the computer as one component to be integrated into an overall instructional delivery system utilizing a variety of mediated forms of communication between the learner and the instructional institution.

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MICROCOMPUTERS IN SASKATCHEWAN SCHOOLS
1984 - 1994
A Report on the results of the SACE'89 Survey

Dr. L.F. (Len) Proctor

INTRODUCTION

1989 marked the tenth anniversary of the formation of Saskatchewan Association for Computers in Education. While the role of technology may vary from school to school and classroom to classroom, computers have become flexible tools for teachers to use as they see fit. Over the last decade, computers have been seen to be objects-of-instruction, aids-to-instruction, and/or made to serve as tools for students, teachers and administrators.

The computer-as-subject approach covers such topics as the history of computing, computer architecture and computer programming. The integration of computers into instruction to help teachers achieve existing instructional goals represents the aid-to-instruction approach. Drill and practice programs and instructional games are two traditional examples of the use of computer-assisted instruction in the classroom. The tool approach is represented by the use of an applications package such as a word processor. Word processors can aid the student in the development of writing skills, the teacher in developing and presenting learning resources and the administrator in facilitation of office communication.

The encouragement of educators to adopt and integrate computer technology into the school system has come in many forms, one of which is funding. Money for the purchase of computing equipment has come from school board budgets, Educational Development Funds granted by the Department of Education, and fund raising activities sponsored by parent-teacher groups. Encouragement has also come in the form of new curricula, computer literacy courses, and teacher inservice programs.

Given the diversity of background in the way in which computers are being used, and the

manner in which their use has been encouraged, it was decided that it was time to take stock. What do we have in the province of Saskatchewan for microcomputer resources? Who is using computers and how are they being used? Are the requirements for in-service training and pre-service training being met? Are there problems or concerns that have arisen that impede the use of computers? The purpose of this study has been to look for trends or themes that will help bring answers to these questions.

DESIGN OF THE SURVEY

Population

The names and addresses of each school in the Province of Saskatchewan was provided by Saskatchewan Education. In the 1988-89 school year there were 941 active schools, 12,224 teachers and 204,626 students.

The Survey Instrument

The survey instrument used in this study was adapted from an instrument used by Petruk in his 1986 survey of instructional computing resources in Alberta Schools (Petruk, 1986). The major focus of Petruk's instrument was to gather information about the nature of instructional computing resources in the Province of Alberta. The instrument used in the current study gathered the same kind of information on instructional computing resources but added the request for information on the use of the computer as an object of instruction, a tool during instruction, a vehicle to deliver instruction and method of managing instruction.

Procedures

The survey instrument was mailed to the principal of each school in Saskatchewan on May 21, 1989 along with a covering letter indicating that the theme for SACE'89 (the annual conference of the

Saskatchewan Association for Computers in Education) was "Decades of Decisions". 1989 is the 10th anniversary of the SACE group. The intent was to compare past resources, current resources and potential computing resources in order to determine if there were patterns or trends evident in the acquisition, location, and utilization of instructional computing resources in Saskatchewan schools.

As each survey form was returned, the results were tabulated and cumulated. dBase III Plus was used to generate the summary reports used in the analysis of the results. Of the 941 questionnaires sent out, 490 (52%) were returned by September 30, 1989. Because of time constraints, no follow-up letters or phone calls were made to encourage responses from schools who had not returned the questionnaire.

DATA ANALYSIS

The intent of this survey was to gain some insight into where we were five years ago, where we are now and, what the state of microcomputers will be in Saskatchewan five years hence. Ideally, a response rate of 100% would be the best basis on which to suggest themes or trends. However, like most surveys, a response rate of 100% is rarely achievable. Therefore, in order to facilitate the process of reporting, the responses were extrapolated to approximate the total number of responses that would have been available, had the response rate been 100%.

Calculations Based on Category Response Rate

The return rate for each category was calculated. For example, in Category 1, the Elementary School, there are 182 schools. 97 of these schools responded to the survey. This gives the response rate of 53%. If the tally for Apple II computers in 1984 was 66 units, and 53% of the schools responded, then 53/100 is equal to 66/X. Solving the equation gives a proportionally adjusted unit count of 124 Apple II computers. Table 2 shows a summary of how this calculation was made for each of the seven categories of schools.

TABLE II Number of Apple II Type Computers in Saskatchewan Schools

School Grade Level Group	Percent Responding	Raw Count Apple II 84	89	94	Proportionally Adjusted Count 84	89	94
Elementary	53	66	659	546	124	1236	1024
Junior High	59	24	126	187	41	214	318
Senior High	63	200	489	284	318	778	452
Elem/Jr. High	46	145	857	744	313	1851	1607
Jr./Sr. High	75	123	292	298	163	387	395
Elem/Jr./Sr.	52	266	991	882	514	1914	1704
Special	27	0	5	7	0	18	26
TOTALS		824	3419	2948	1473	6399	5526

Similarly, in Category 2, Junior High, there were 17 schools; 10 responded. Category 3, Senior High, 70 schools; 44 responded. Category 4, Elementary/Junior High, 378 schools; 175 responded. Category 5, Junior/Senior High, 57 schools; 43 responded. Category 6, Elementary/Junior/Senior High, 266 schools, 117 responded. Category 7, Special schools, 11 schools; 3 responded.

Global Calculations

In this calculation, extrapolated data were cumulated by year and by computer type. The results were then converted to percentages to facilitate comparison. Table 3 shows an example of how this type of calculation was made.

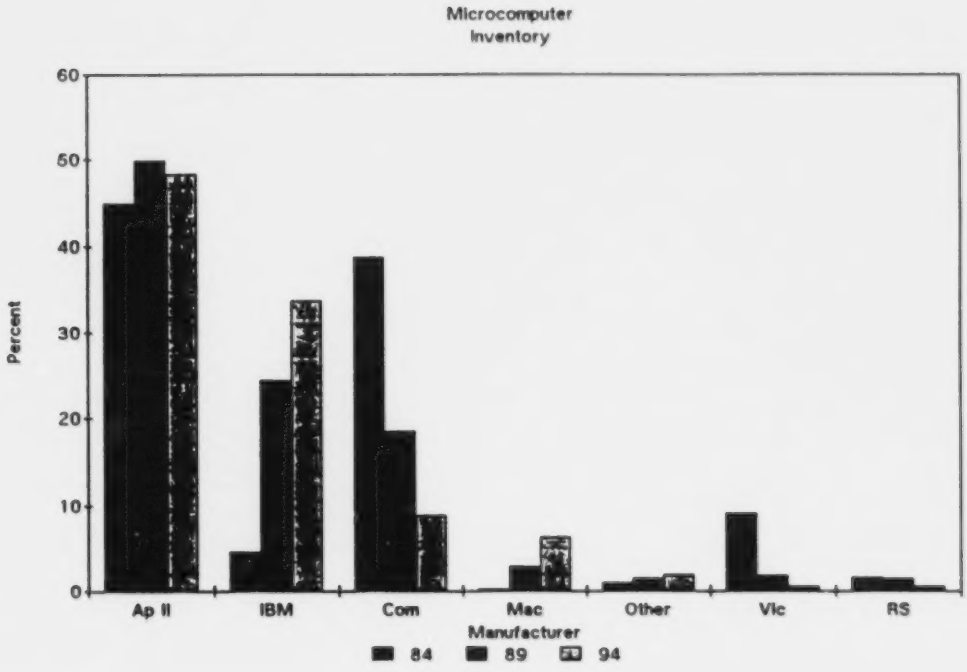
Table 3: Types of Computers Found Saskatchewan Schools

	Microcomputer Inventory			Distribution by Percent		
	84	89	94	84	89	94
Apple II and Clones	1,473	6,399	5,526	45	50	48
Apple Macintosh	6	367	723	.2	3	6
Commodore	1,272	2,363	1,012	39	18	9
Commodore Vic 20	297	226	59	9	2	1
Radio Shack	53	187	58	2	1	1
IBM and Compatibles	149	3,127	3,857	5	24	34
Others	31	183	216	1	1	1
	3,281	12,850	11,451	100	100	100

FINDINGS

Graph 1 summarizes the inventory of microcomputers, by brand type, for the years 1984 - 1994. The total number of microcomputers as of June 30, 1989, repoted by schools participating in this study (490), was 7,102. Extrapolating this total to encompass all of the schools in the province (941) would bring the estimated number of microcomputrs in schools to 12,850. For the 941 schools, this means that there is an estimated average of 13.7 microcomputers per school. Or, expressed in terms of the number of teachers (12,224), approximately one microcomputer for every teacher. In student terms (204,626), one for every 17 students in the school system.

GRAPH 1



Microcomputer Inventory

Five years ago in 1984, the total estimated number of computers was 3,281. As of June 30, 1989, almost 10,000 computers had been added to the school's equipment inventories. In contrast, the projected number of computers that will be available in schools by June 30, 1994 is 11,451, an overall decrease of some 1400 computers over the inventory held of June 30, 1989.

Microcomputers, like transportation vehicles, age and will have to be replaced. For example, Commodore computers starting out at 43% of the available equipment in 1984 and declining to 9% by 1994, illustrates this point. Several obsolete models such as the Commodore Pet, Vic 20 and various

Radio Shack models which represent 23% of the 1989 inventory, or 2776 machines will have to be replaced in the near future. The replacement of aging equipment may have been a contributing factor to the projection of a reduction of the number of microcomputers in schools for 1994.

In 1984, the relative percentage (number of brand X/total number of computers for the year) of Apple II type computers was 50%. In relative terms, this pattern is still present and is projected to be maintained for the next five years. Over the ten year period, one-half of all the microcomputers in the schools were, are, and will be of the Apple II type.

The number of IBM computers and its clones appears to be increasing. These machines started out in 1984 at 5% of the inventory, grew to 25% by 1989, and will grow to 34% of the available equipment by 1994.

The Macintosh has just been discovered by the schools. In 1984, Mac represented .2% of the microcomputer inventory. It grew to 3% by 1989 and is projected to occupy 6% by 1994.

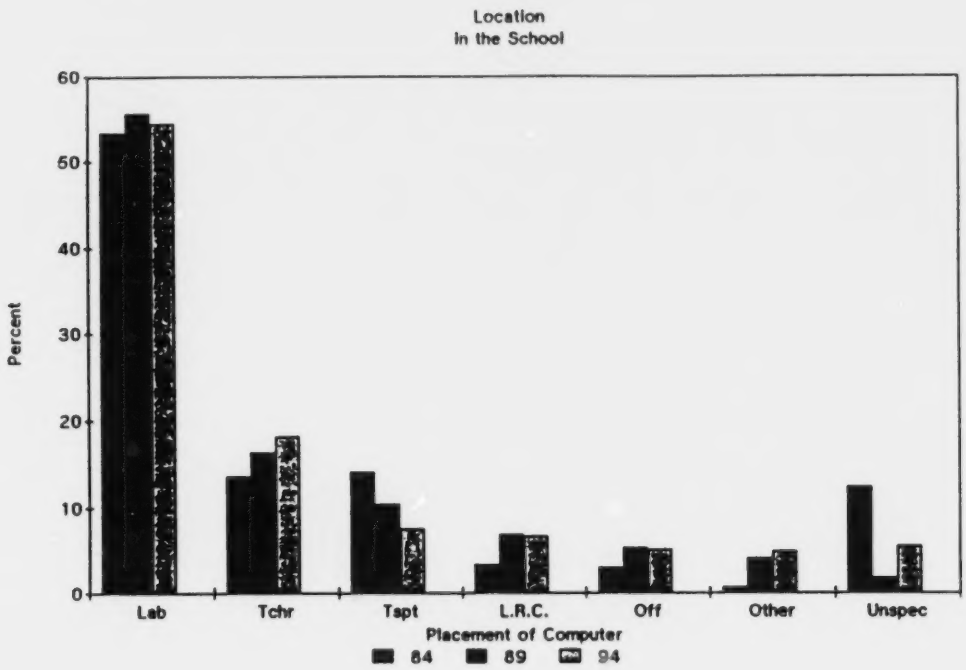
Other brands of machines such as the Icon, Amiga, Corona, and Atari are present in the schools, but in very small numbers.

Location of Microcomputers in the School

Graph 2 summarizes where computers are located in the school buildings. Relative to the number of computers available each year, over half (56%) are located in general purpose microcomputer labs. 16% are assigned to classrooms, and 10% are moved from classroom to classroom on a rotating basis. The same pattern of distribution was evident five years ago and not much change is projected to occur over the next five years.

While the majority of computers are allocated to areas where formal instruction is taking place, a few microcomputers are located in other important areas. The library (L.R.C.), has increased from 3 in 1984 to 7% currently. Administrative offices have gone from 3 to 5%. Other locations in the school such as the resource room, staff room, guidance office, band room, teacher preparation room, have

GRAPH 2



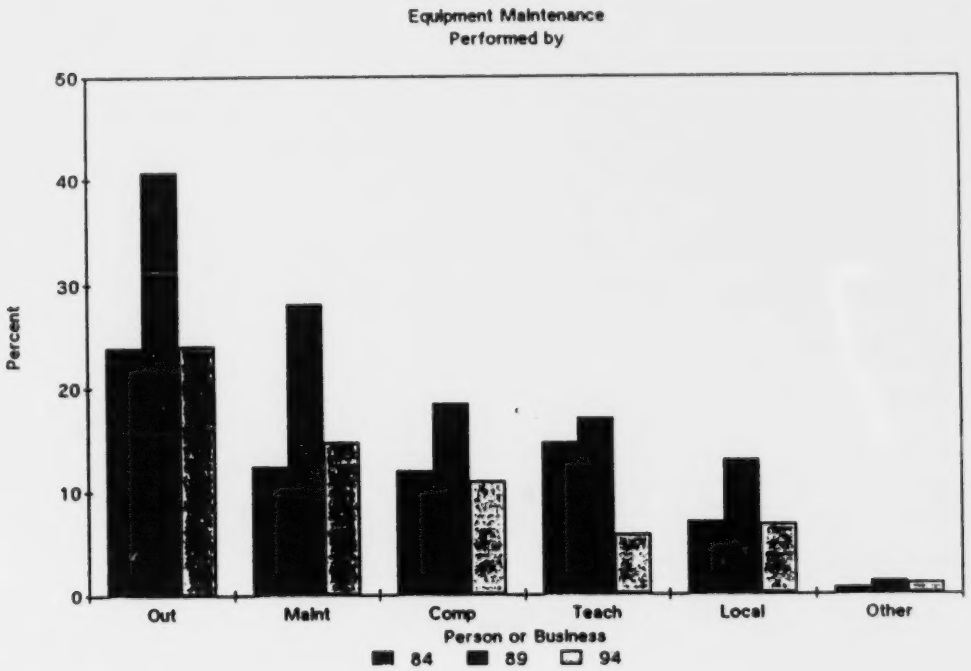
moved from 1% in 1984 to 5% in 1994. Labs, hallways and storerooms were also identified as areas where computers have been located due to the lack of space to place them elsewhere.

Maintenance of Computer Equipment

The respondents were asked to indicate which choice best described the manner computer maintenance was performed in their schools. In any school setting, the mechanical components of a computer such as the keyboard and teh disk drives are subject to very heavy use, frequently by new

and inexperienced users. It is simply a matter of time until preventative and restorative maintenance has to be carried out on each machine. As summarized in Graph 3, 41% of the maintenance is carried out by commercial business outside the local city or town in 1989. About a quarter of the requirements were met by a local maintenance technician attached to the central office. Local business perform about 13% of the maintenance needs and the remainder is handled by an interested teacher (17%) or designated computer person (18%) resident in the school. In general, although the percentages may be lower, this has been the pattern and will be the pattern for the next five years except for teacher involvement. It is predicted that teacher involvement in computer maintenance will drop from 15% to 6% over the ten year period time span being reviewed.

GRAPH 3

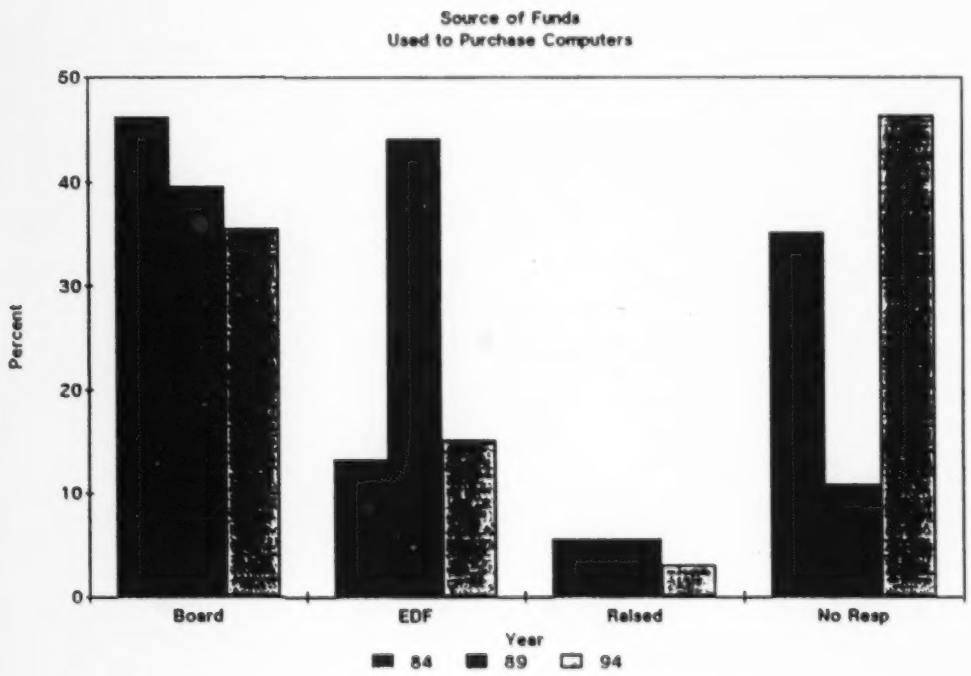


Source of Funds

Respondents were asked to identify the major source of funds available for the purchase of computer hardware. Their responses could be divided up into three categories; regular school budgets, EDF grants, and locally raised funds from home and school groups or private donations. The results are summarized in Graph 4.

In 1989, it was estimated that 40% of the respondents used funds to purchase computer hardware that came from the regular school budgets. 44% received EDF grants, and 6% had funds or equipment donations or set up local fund raising activities. Over the years 1984 - 1994, it would appear that the proportion of respondents using the regular budgeting process has remained relatively stable. On the other hand, success at receiving EDF grant funds grew from a low of 13% in 1984 to a high of 44% by 1989. EDF grants are projected to drop back to 15% in 1994. Respondents relying on local fund raising activities for the purchase of computer hardware remains relatively small at 3 to 6%.

GRAPH 4

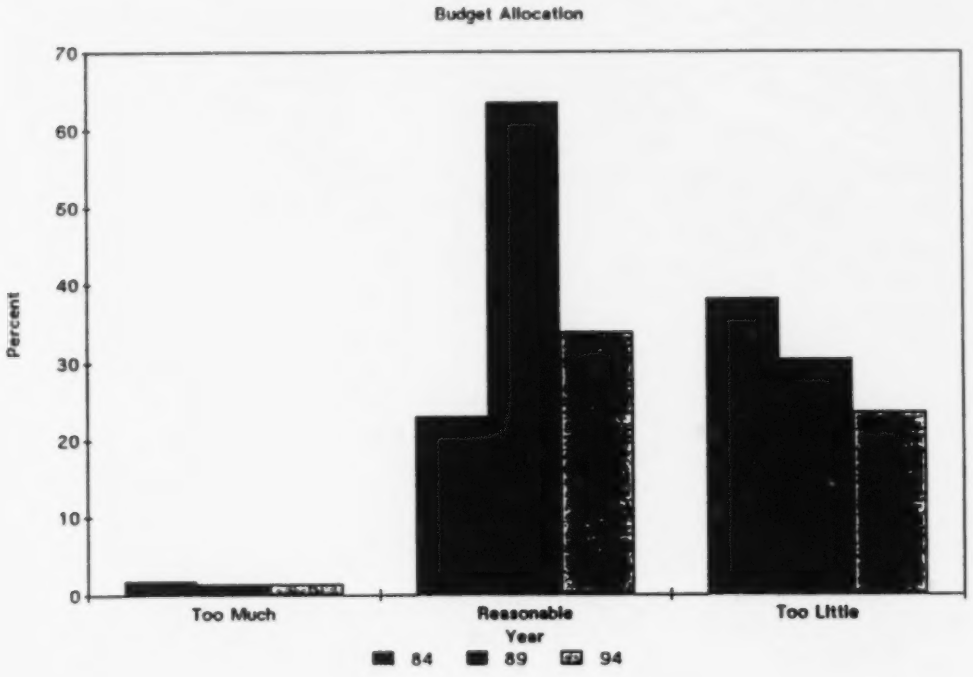


Budget

The respondents were asked to express their feelings about the amount of money being spent on computers relative to other needs in the school. The results are summarized in Graph 5. In 1989, two thirds of the respondents felt that the amount of money being spent on computers was reasponable. Just under one third of the respondents felt that there was too little spent and only 1% felt that too much money was being spent on computers.

Compared to five years ago, the feeling that too little money was being spent on computers was slightly more prevalent. Five years hence, it is anticipated by about one quarter of the respondents that too little money will still be spent on computing equipment.

GRAPH 5



Buildings and Facilities

The respondents were asked to indicate which of the following statements identified an area which had been a problem, was a problem, or will be a problem in 1994. The results are summarized in Table 4. The problem identified as being of most concern to the respondents was that of procuring and maintaining software (62%). This was closely followed by the need to provide adequate access to microcomputers (52%) and the need for proper maintenance (50%) of the microcomputers.

Table 4: Problems Related to Buildings and Facilities

	1984	1989	1994
Determining an appropriate location	34	36	17
Providing adequate access	31	52	28
Determining an appropriate spatial layout for the microcomputer facility	19	31	17
Providing adequate environmental conditions	21	35	21
Providing adequate physical security	16	31	22
Providing adequate storage for computer related equipment and supplies	18	39	24
Procuring adequately designed workstations	21	34	21
Providing telecommunications links	13	24	32
Providing display monitors and screens for classrooms	18	44	37
Meeting the power requirements for micros	14	17	10
Maintaining the micros	21	50	39
Procuring and maintaining software	24	62	43
Other	1	3	2

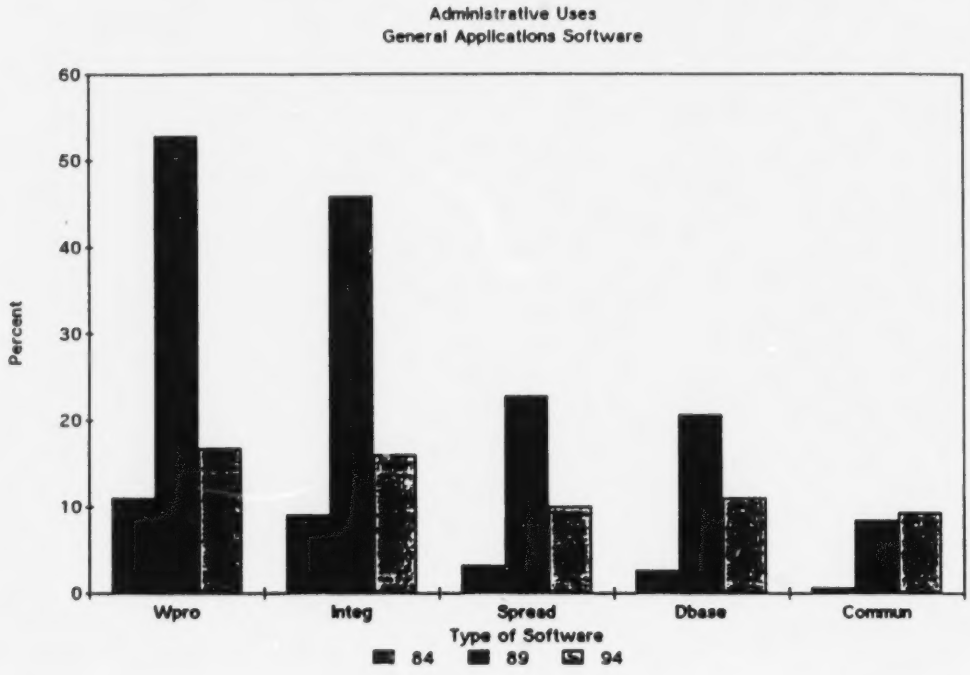
Other items identified as potential problem areas were the need for more hardware, software evaluation, release time for the teacher who manages the facility and updating obsolete equipment.

Administrative Uses of Productivity Software

Productivity software may be divided into two categories, general programs and task specific programs. Graph 6 summarizes the use of general applications software program. Of the four major

types of general applications software (word processing, spreadsheet, database and communication packages), word processing programs are being used by all of the respondents (51%) that indicated that they use one or more computers in the office for administrative purposes. Spreadsheets are next, with 23% utilization, databases at 21% and 8% of the respondents use a communication program.

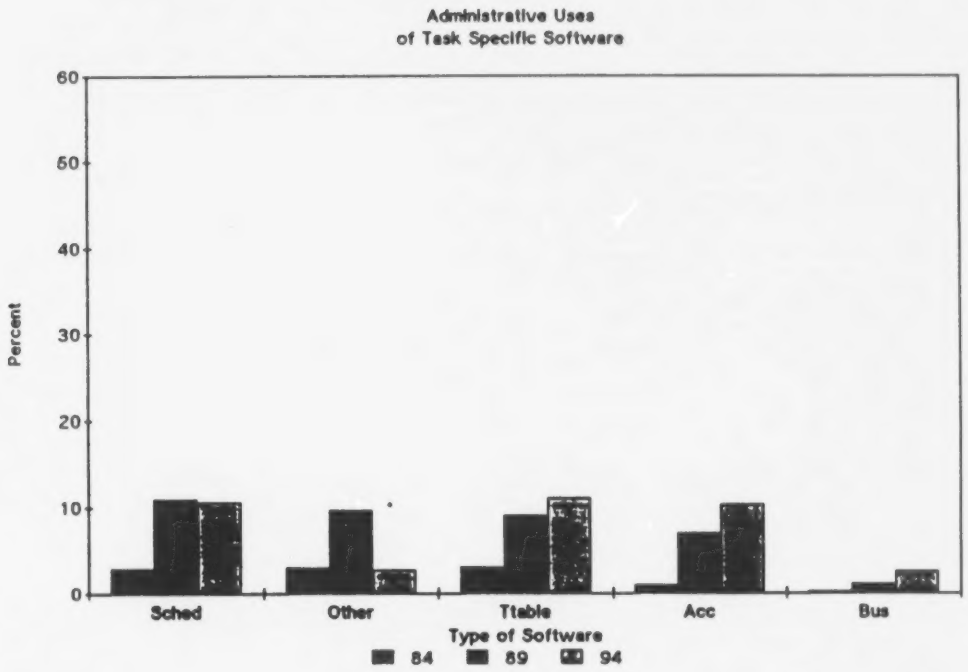
GRAPH 6



Current utilization of productivity software for administrative purposes is up significantly from what it was five years ago. Then only 11% used word processing and very few schools used spreadsheets, databases or communications. Predictions for five years hence suggest reduced utilization of word processing, spreadsheets and databases and about the same utilization of communications.

The use of task specific programs is summarized in Graph 7. Scheduling, accounting, and timetabling are used by about 10% of the respondents. This is up from where it was five years ago. The anticipated utilizaiton for the next five years will remain at about the same level as it is now. School bus scheduling has been, is and will likely remain a low priority for administrative productivity software.

GRAPH 7



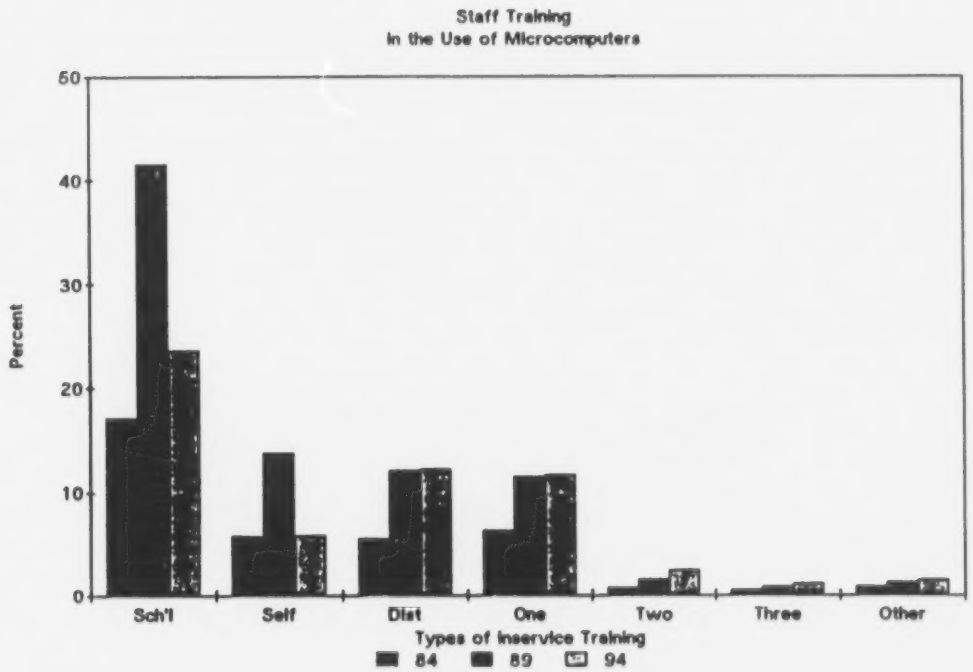
A few respondents indicated that they were beginning to use attendance, academic records, guidance, desktop publishing and Canada Fitness packages.

Staff Training in the Use of Microcomputers

The respondents were asked to estimate the number of teachers per year who participated in professional development opportunities related to the use of microcomputers in education. The results, as summarized in Graph 8, indicate that in 1988-89, 69% of the 12,224 teachers particiapted in organized inservice activities. This is made up of local school-based workshops, (42%) and district-sponsored workshops (12%), and one or more university courses (15%). Independent study activities accounted for 12%.

The level of inservice activity for all categories is about double what it was five years ago. The proejcted demand for 1994 goes in the opposite direction. School sponsored workshops will drop to 24% and self-learning will return to the 1984 level of 6%.

GRAPH 8

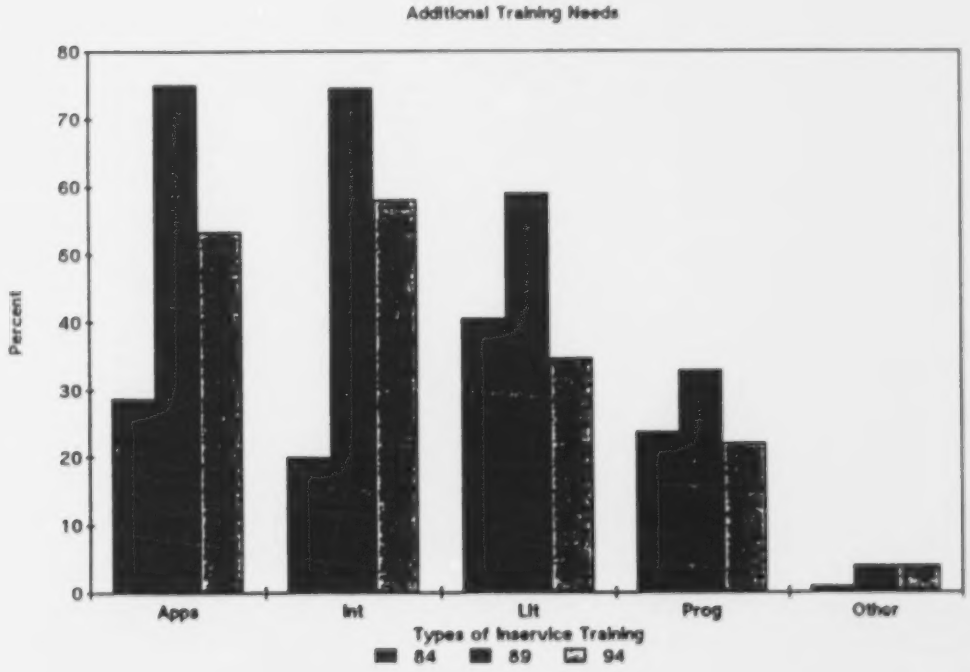


Additional Training Needs

Respondents were also asked to indicate what additional training needs would be required for their staff. The results are summarized in Graph 9. Of the 941 schools, 75% indicated that they need additional training in computer applications, 74% on the integration of computers into the curriculum, and 59% in computer literacy. 33% indicate the need for additional training in computer programming.

Compared to five years ago, there is a substantial increase in the perception of need for additional professional development opportunities in the use of productivity software (29 to 75%) and the integration of computers into the curriculum (29 to 74%). Although moderately reduced, the need for additional training in these two areas will still be present five years from now.

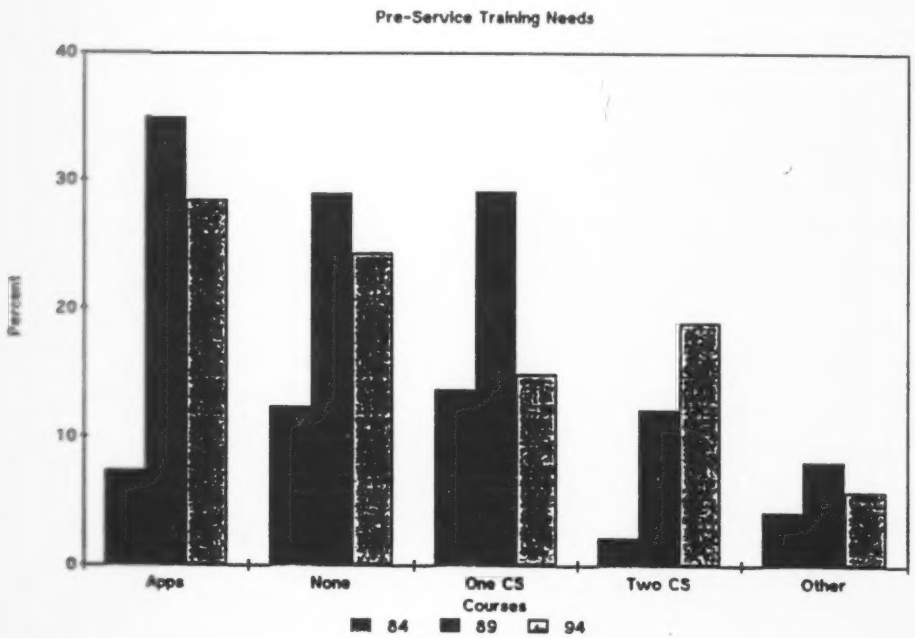
GRAPH 9



Pre-service Training Needs

For this question, respondents were asked to give their opinion on the minimum amount of pre-service training in the instructional uses of microcomputers that prospective teachers need. The results are summarized in Graph 10. 35% of the respondents indicated that one university course in computer applications would be required. 29% indicated that one course in computer science would be required while an equal number responded that no course should be required but rather computers should be integrated into instruction, i.e. the "methods of teaching" courses. 12% indicated that two university computer science courses should be required.

GRAPH 10



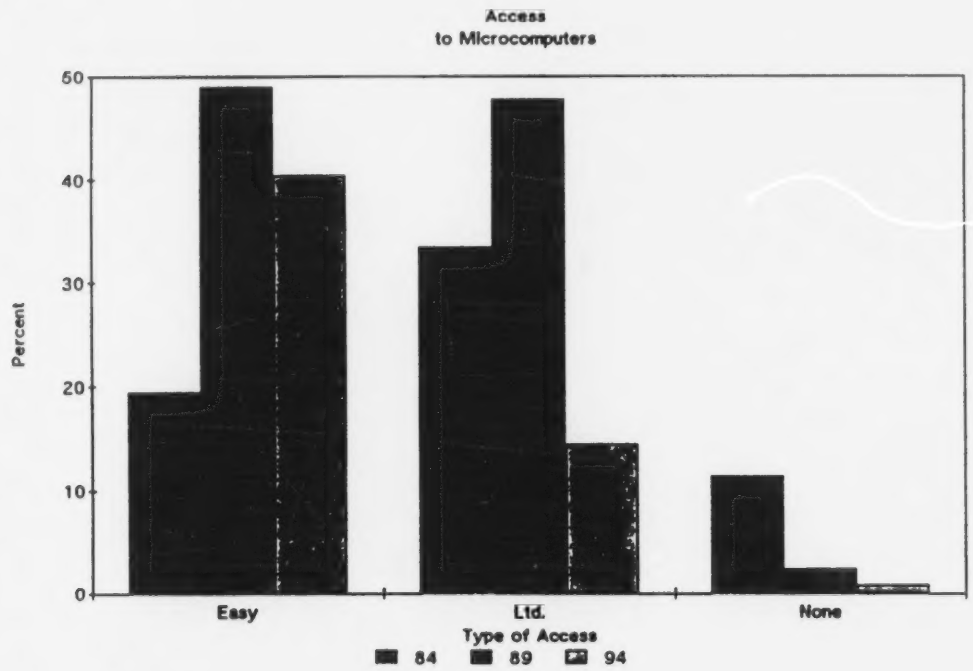
Compared to five years ago, the perceived need for the amount of pre-service training in the use of computers has more than doubled. In contrast, the projected need for preservice training in computer applications, computer science, and the integration of computers into coursework will drop 7-14%. The recommendation for two computer science courses will increase from 12 to 19%.

Access to Microcomputers

To what extent do students and teachers have access to microcomputers beyond the normal class times? As summarized in Graph 11, in 1989, the responses were about equally divided between easy access where they may use the microcomputer any time during the school day and limited access where the microcomputer may be used only on specified days or specified hours during the day.

Five years ago, the split was about 19% easy access, 33% limited access and 11% no access. Five years from now, it is predicted that the reverse will be true, 40% easy access, 14% limited access, and 1% no access. Inevitably, increasing skills will precipitate a demand for increasing access to important learning tools. There appears to be a willingness to meet this need.

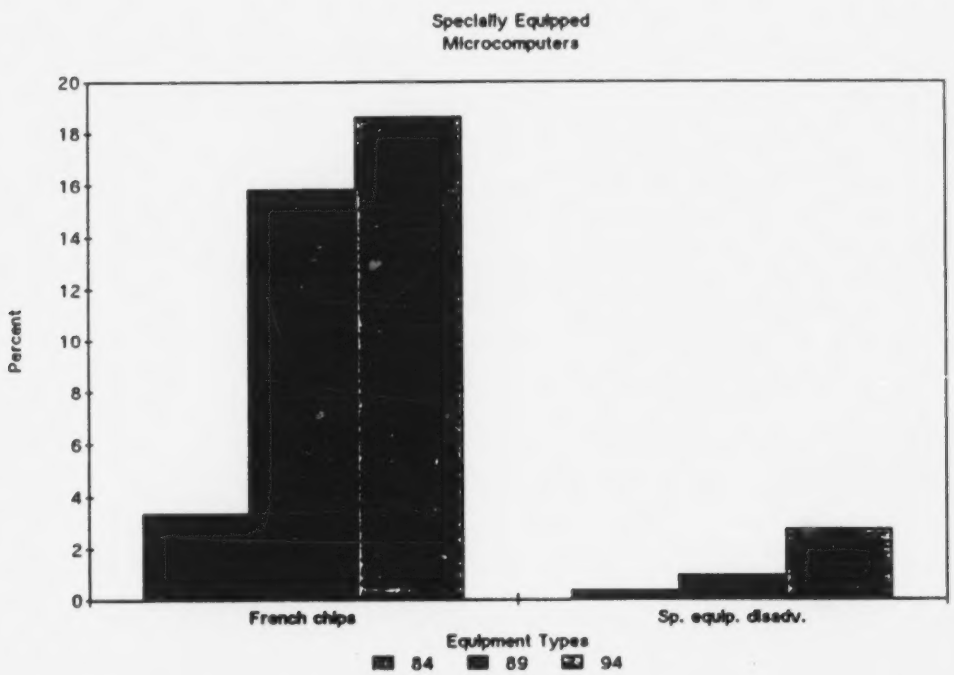
GRAPH 11



Specially Equipped Microcomputers

As microcomputers become more powerful, they are more easily adapted to specialized applications such as using different language character sets and allowing input from customized keyboards or other specialized input devices. As summarized in Graph 12, in 1989, an estimated 2033 computers (16%) of microcomputers had resident chips capable of generating French characters sets. 1% of the microcomputers were equipped with special input devices, other than a keyboard, to accommodate the needs of physically handicapped students.

GRAPH 12



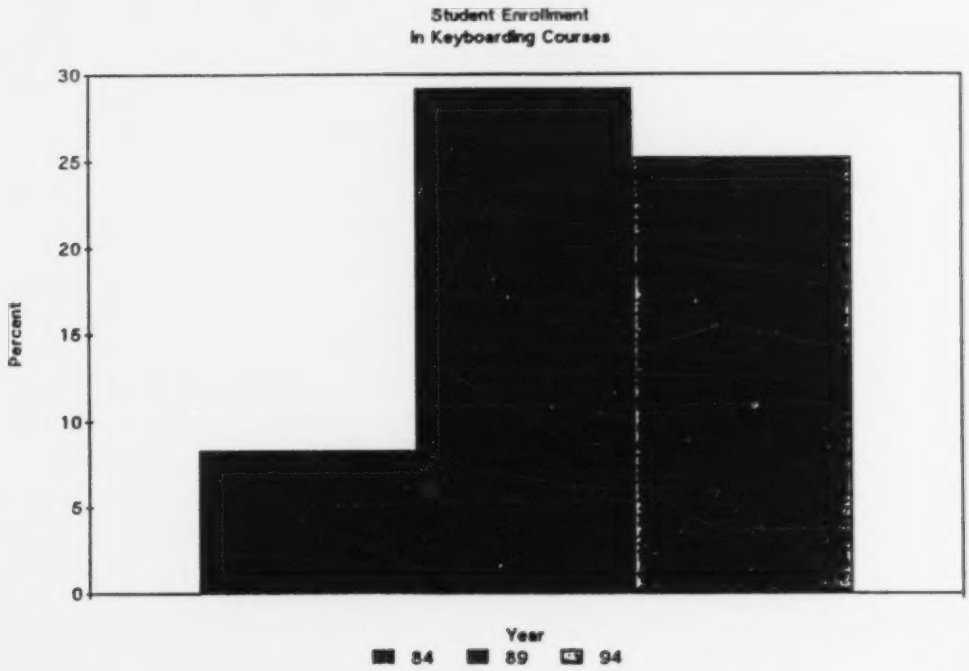
While this is up significantly from the 3% (110) and .4% (12) respectively five years ago, five years hence it is projected that there will be only a 3% rise to 19% for French character generating chips and a 2% rise to 3% for special input devices.

Keyboarding

The respondents were asked to estimate the number of students who were enrolled in one or more keyboarding courses five years ago, the number that are currently enrolled, and the number that will likely be enrolled five years hence. The keyboard is still the primary means of text or data entry into the computer. The greater the proficiency at the keyboard, the higher the probability of increasing personal productivity and decreasing stress levels.

As summarized in Graph 13, in 1989, 29% of the students in Saskatchewan schools are enrolled in one or more keyboarding courses. This is over three times the 1985 enrollment level of 8%. Projections for 1994 enrollments are down slightly to 25% of the students.

GRAPH 13

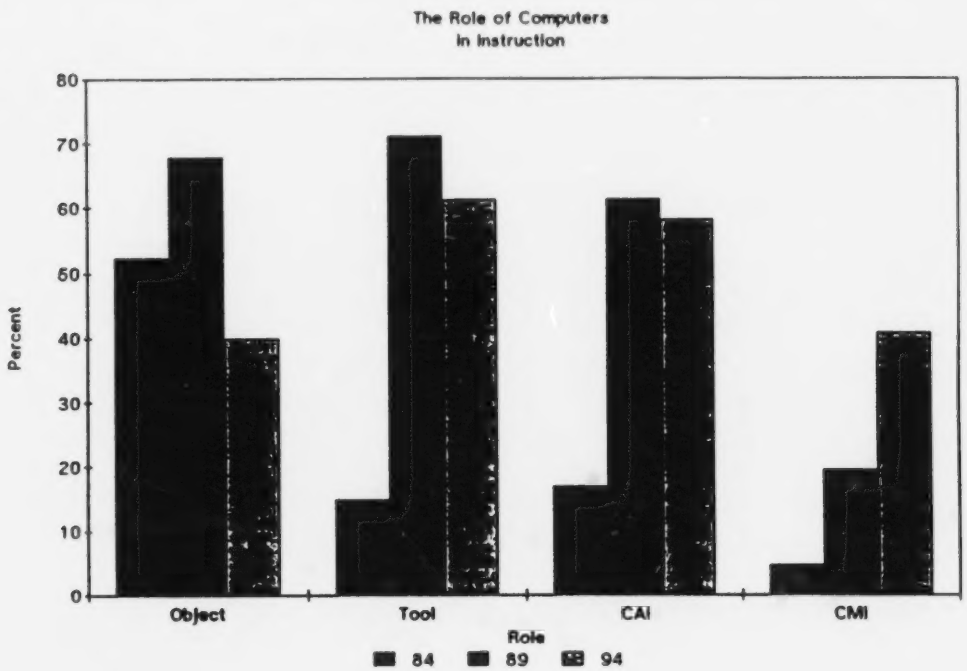


The Role of Computers

The respondents were asked to indicate how computers are being used in their schools. The results are summarized in Graph 14. 68% indicated that the computer was used as an object of instruction. Students were learning how to program computers and about computer hardware function and operation. 71% indicated that computers were being used as a personal productivity tool. Students were learning to use word processors to help them develop creative writing skills, spreadsheets to solve mathematical problems and so on. 61% indicated that computers were being used to deliver instruction. Students were interacting with the computer as part of the process for learning the content of the subject they were studying. 19% indicated that they were using the computer as a management tool. Student records and information about their performance was being stored in the computer and being used to prescribe or control individualized lessons.

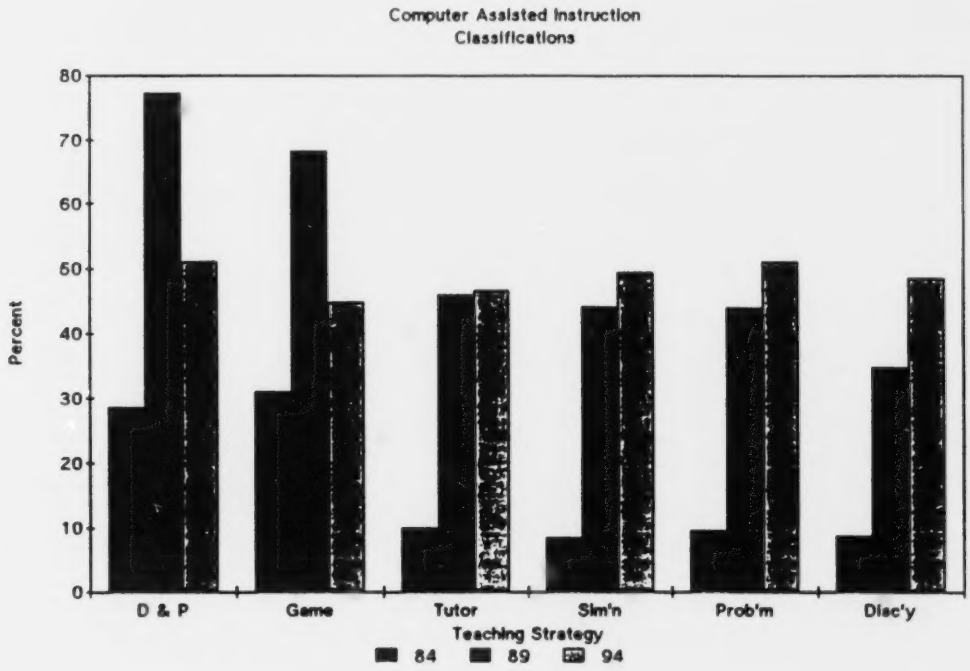
In 1984, 52% of the respondents made use of the computer as an object of instruction, but by 1994, only 40% of the respondents are predicting that they will use computers for this purpose. The study of computers in the sense of computer science is on the decline. In contrast, the number of respondents indicating that they will use the computer as a productivity tool will increase from 15% of the respondents in 1984 to 61% in 1994. The projected use of the computer to deliver instruction and manage instruction will follow a similar pattern.

GRAPH 14



The use of the computer to deliver instruction is summarized in Graph 15. 77% of the respondents indicated that drill and practice programs were being used. This is up from 29% five years ago. Five years hence, only about half of the respondents indicated that they will be using these kinds of programs. The same trend is evident in the use of gaming programs. The reverse is true for other teaching/learning strategies. About half of the respondents indicated that they will use tutorial, simulation, problem solving and discovery types of programs. This is up from about 10% of the respondents in 1984. The projected use of these kinds of programs will remain at the current level of perhaps increase slightly over the next five years.

GRAPH 15



Computer Using Teachers

Respondents were asked to list the names and areas of specialization of up to three teachers in their school who were making extensive use of computers in their classrooms. 381 of the 490 respondents (77.8%) indicated that they had at least one teacher who was making extensive use of computers in their school. When this data was extrapolated to include the entire teaching force in the province, of the 12,224 teachers, an estimated 1953 (16%) have been identified as computer using teachers. Table 5 shows the distribution.

Table 5: Distribution of Teachers Who Make Extensive Use of Computers

School Classification	Number of Schools With at Least One Computer User		Estimated Number of Computer Using Teachers	
Elementary/Jr.High	123	(33%)	700	(5.7%)
Elementary/Jr.Sr	103	(46%)	535	(4.4%)
Elementary	76	(42%)	383	(3.1%)
Senior High	37	(53%)	156	(1.3%)
Jr./Sr. High	31	(54%)	111	(0.9%)
Junior High	9	(53%)	61	(0.5%)
Special	2	(18%)	7	(0.1%)
TOTALS	381		1953	(16.0%)

Schools classified as elementary/junior high have the highest number of computer using teachers. There are 378 schools of which 123 (33%) responded to the survey. 4,229 of the 12,224 teachers in the province teach in these schools. There are an estimated 700 teachers at this level who make extensive use of computers. This segment of computer using teachers represents 5.7% of the entire teaching force.

DISCUSSIONS AND CONCLUSIONS

It is estimated that 10,000 computers have been added to school inventories in the last five years. The Apple II series is the most prevalent, particulary in Elementary and multi-division level schools. It accounts for at least one half of all of the computers in the system. In the future, four trends are evident. The Apple II series will likely maintain their presence. I.B.M. and its clones will grow in popularity, particularly at the Senior High School level. Third, the number of Commodore machines present in all levels of school will decline. In contrast, the Macintosh seems to be slowly gaining in popularity at all levels.

About one-half of the computers in the schools are located in labs and are likely to remain in this location for the time being. However, there is a modest trend beginning to emerge toward the assignment of computers to specific classrooms. While still low, this trend may compete with the mobile computer on a cart approach and the placement of computers in school libraries or resource centers.

Much of the maintenance of computers is done by outside commercial firms; but, when added together, the contribution of teachers, computer consultants and locally employed maintenance personnel, is substantial. They will likely continue to do routine preventative maintenance, and network management. Only the serious mechanical or electronic problems will be sent out for repair.

School board budgets and E.D.F. funds are the most important sources of money to purchase computer hardware. While the availability peak of E.D.F. funds may have passed, there is a feeling that the amount of money allocated to purchasing computers has been reasonable. While there is a suggestion that the notion of "too little funding" being spent on computers is declining, there will still be considerable pressure on these two budget sources.

Three main problems regarding buildings and facilities were identified. Concern for the ability to provide adequate levels of hardware and software were expressed. Further, easy access to computers and the need to provide proper maintenance on the equipment were also identified as topics that needed to be addressed.

For administrative purposes, general applications programs such as the word processor were the most popular. Spreadsheets and database programs are also being used, but communications programs are the most likely to increase in importance. Specialized software for timetabling, accounting and bus scheduling are being used but are not major administrative tools. Desktop publishing, fitness assessment and counselling programs are beginning to come into use.

Local school and Division level workshops figure prominently in in-service training programs. The need for continued training in computer applications, computer literacy and the integration of computers into classroom instruction will remain. While there is still a perceived need for training in computer programming, relative to the other training needs, it is lower. For pre-service training, computer applications and integration are and will continue to be important. One or two computer science courses are seen as being an important part of a pre-service teacher education program.

Access to computers after normal school hours is becoming easier. Few respondents predicted that there would be limited or no access to computers after hours. While access to computers may be a declining problem, specialized equipment for the physically handicapped students may be an increasing problem. Not much equipment was reported to exist or is predicted to be purchased. However, a substantial number of computers are able to display French character sets.

The development of keyboarding skills was seen to be important. Almost one-third of the student population was enrolled in one or more keyboarding courses during the 1988 academic year.

The role of the computer as an object-of-instruction and the productivity tool approach was seen to be declining. On the other hand, the use of the computer to deliver and manage instruction was seen to be increasing. Tutorial instruction, simulation, problem solving and discovery learning were projected to figure prominently in this application.

Finally, an estimated 1953 teachers have been identified as making extensive use of the computer in their classrooms. This represents 16% of the teaching force. Almost one-half of the schools have at least one of these teachers on their staffs. The largest group of computer using teachers are located in the K-9, Elementary/Junior High Schools.

ANALYTICAL TOOLS AND RESEARCH ISSUES FOR INTERACTIVE MEDIA

Richard A. Schwier & Earl R. Misanchuk

In traditional (linear) media, such as audio materials, video or film, or combinations of still pictures and audio, any learner going through the materials is offered essentially the same learning experience as any other learner going through the same materials (given reasonably similar levels of motivation). As a consequence, instructional designers have been able to assume a certain constancy to their instruction. Now, however, the proliferation of interactive technologies and hypermedia has given instructional designers the capability of producing materials which provide for a great deal of choice on the part of learners in determining their paths through the instruction. This means that two learners may be able to traverse the same instructional materials, perhaps even achieve the same objectives, yet not share a common experience. At minimum, the degree of commonality in the experience is reduced over that experienced with the more linear media. While obviously having a liberalizing (some would say humanizing) effect on instruction, the advent of interactive and hypermediated technologies brings with them a host of new questions for instructional designers, as well. Among these is the determination of the effects of taking different paths through instruction. To address such a question requires that there be some way of recording and analyzing the instructional path taken by each learner. We refer to that record of the path as the audit trail (after M. W. Petruk, personal communication, February 7, 1990).

It is a relatively simple matter to collect information about an individual's path, using contemporary computer-based instruction authoring environments (e.g., Authorware Professional or Course of Action) or program development tools such as Macintosh's HyperCard. Learners' responses can be trapped and recorded at each decision point, or node. Of course, the descriptive data captured can provide very useful formative evaluation information. However, we speculate that there are additional purposes to which such information can be put, purposes that might produce generalizable

rules about the construction of various paths through interactive and hypermediated instruction. In order to generate such rules, however, questions of this type must be asked and answered: Can we confidently state that one path is significantly different from another path? Can we combine groups of paths and compare them to other groups of paths--a necessary step if we intend to refine individual differences research in interactive media?

To illustrate the desirability of pursuing this type of research, consider that individuals, and indeed groups of individuals, can approach instruction differently, and this has traditionally been of theoretical interest. For a simple example, we might consider an issue like racism. Suppose an instructional developer is developing video materials for a Canadian (i.e., multi-cultural) audience. Might the race of an on-camera instructor influence choices made by a learner within the instructional sequence? What about other characteristic--socioeconomic status, gender, age, religion? Would any or all of these characteristics influence the ultimate path taken through the instruction?

As a second example, we could focus on any of a number of individual differences or cognitive styles; consider 'locus of control.' How might internalizers and externalizers differ in their approaches to highly organized interactive treatments? Would they react differently to, and take different paths through, very linear treatments and hypermedia treatments? One learner may select the shortest path available; another may select every available remedial segment in the same treatment. Resultant paths would be very different from one another, but, short of actually watching both individuals progress through the materials, how can these differences be expressed? As interest grows in the effectiveness of learner control of instruction (e.g., see Higginbotham-Wheat, 1990; Lopez, 1990; Ross, Morrison, & O'Dell, 1990; Steinberg, 1977), and especially as it broadens into learner control of interactive and hypermediated instruction, these kinds of questions will command increasing interest.

In order to explore these types of questions, we need some analytical tools that don't appear to have been developed yet. As this area of investigation is still very new, prescriptions are not yet at hand. Some preliminary work on the subject has been done, however, and we attempt in this paper

to represent in some meaningful ways the different paths that individuals may follow through interactive media treatments. We identify both descriptive and inferential approaches to analyzing interactive media audit trails, and identify some of the issues and concerns that such investigation reveals. We also attempt to identify research opportunities in interactive technologies of instruction that such analysis would promote.

The Audit Trail

An audit trail comprises all the responses generated by a learner going through interactive or hypermediated instruction. In general terms, audit trails contain words, phrases, sentences, and paragraphs that a learner types into a computer, as well as a record of the 'multiple choice'-like responses made, either from the keyboard or via some other input device, such as a mouse or touch-sensitive screen. However, to keep this preliminary discussion relatively simple, we restrict our discussion here to the "multiple choice"-like responses. Hence, we conceive of the audit trail as a string of characters (numerals or letters) representing choices made by learners as they progress through choice points, or nodes, within the instruction. For example, suppose the first point at which a learner had to make a choice had three different paths the learner could follow, and let us further suppose that she chooses the second path. As she proceeds through the subsequent instruction, she encounters a second node, with two choices, and chooses the first of those. The first two characters of her audit trail would therefore be 21 (read "two-one", not "twenty-one"). If she then chooses the first of three paths at the next node, and the third of three at the following node, her complete audit trail up to this point would be 2113. A second learner might have chosen the third path at the first node, the first path at the second node, the first path at the third node, and the second path at the fourth node, to give an audit trail of 3112. In creating an audit trail, the computer would simply record the numerical value assigned to each option presented at a decision point, in a vector-like arrangement. As the number of decision points in the treatment increases, so will the length of the vector; as the complexity of the

path taken by an individual increases (e.g., exploring optional paths as opposed to forging straight ahead), so will the length of the vector.

Some things immediately become obvious:

1. The meaning of any character in the audit trail is dependent for meaning upon the character preceding it. That is, the character '1', the second character in the first individual's audit trail, does not mean the same thing as the character '1' which is the second character in the second individual's audit trail, because the two individuals chose different paths at the first node. We will refer to this phenomenon as the dependency problem.

2. A problem is created by repeat visits to a node. In any particular interactive treatment, an individual may intersect the same node in the program more than once. Stated differently, the learner may traverse portions of a path repeatedly. Thus, if a simple frequency count is made of visits to a node, it is difficult to discriminate, for example, between the case in which two learners traverse the same path segment once each, and one in which a single learner traverses the same path segment twice. We will refer to this problem as the looping problem. The looping problem is context-dependent. Interactive treatments are typically designed to permit repeated visits to some portions of instruction but not others. A second implication of this phenomenon is that not all audit trails will be of the same length.

3. The problem of conceptual distance. This is a classical measurement problem which surfaces in the interpretation of data from interactive treatments. Given different treatments, selections at nodes may represent nominal, ordinal or even integer data points, and each type of data imposes restrictions on how data can be analyzed. For example, one menu in a program offers the viewer a choice of 'river memories,' 'river bridges,' 'river travel,' or 'river science.' In this case 'river memories' is represented

as 1 and 'river science' as 4. Because the data are nominal, the numerical representation is misleading; the conceptual distance implied between the two choices is in fact no greater than the conceptual distance between any two other choices from the menu. The problem is not isolated to numerical data. With tree diagrams and other graphic approaches, conceptual distance is implied as branches diverge on a diagram. In actual fact, however, choosing 'A' at the seventh level of the farthest branch on the right side of a diagram is not necessarily different conceptually from choosing 'A' at the fourth level of the left branch. Nevertheless, a casual observer can be seduced into thinking that spatial or numerical distance in data indicate conceptual distance as well.

Descriptive Approaches to the Audit Trail

In our initial search for a meaningful way to represent the audit trail, we investigated and considered several formats. The list we generated, below, is not exhaustive, but merely a point of departure. Some of the representations appear to be more useful and durable than others; some we considered briefly and discarded for various reasons outlined below.

Raw Data Matrix

The most basic way of representing audit trail data is to simply record the responses of each learner (as a vector), one above the other (see Figure 1). Matrices like these have the advantage of being easily constructed and relatively easily interpreted for each individual. The interpretation, however, can only be relatively limited, and context-bound. For crude formative evaluation purposes, the data are useful. An instructional designer can see which choices are attracting individual learners, and speculate about design decisions. But there is a serious limitation with this type of approach: raw data by definition aren't summarized, and therefore conclusions based on the group are difficult to derive.

Nodal Frequencies and Proportions

Another approach we investigated was to present data associated with each decision point (node) in the treatment. Data can be presented in at least two forms, as raw data (Figure 2) or as

proportions (Figure 3).

Raw nodal frequencies, like raw data matrices, are easy to create. They are perhaps easier to interpret, since the data are now summarized. Magnitudes of differences are obvious, and at any node, comparisons have high precision and are intuitively satisfying. At the same time, relationships across nodes, or among variables are difficult to interpret. For example, how should four choices of 'A' at one node be compared with 103 choices of 'A' at another node, if they occupy different locations in the treatment? Perhaps only eight individuals encountered the first node, whereas several hundred encountered the second. The looping problems, described earlier in the paper, surface here to cause difficulties in interpretation. If an individual loops through a node several times, frequency data become distorted. Either the same choice is made several times, thereby inflating the frequencies at that node, or several different choices are made, thereby levelling the data at that decision point.

Nodal data can also be presented proportionally. Again, this type of format is easy to create and precision is retained at a high level. Proportions allow easier comparisons across nodes or among variables at different positions in the treatment. Of course some calculation is necessary, and the user must struggle with the question of what to use as a denominator. For example, is the denominator consistently the total number of learners encountering the treatment, or is the denominator the total number of learners who pass a particular decision point? Perhaps obviously, the denominator of any proportion will be determined by the comparisons the user chooses to make - yet another type of context dependence. As with raw nodal data, proportional data are also sensitive to looping problems. An individual looping several times through a particular node can inflate its proportion of the total. In addition, as one descends deeper into the data matrix, smaller raw numbers represent elevated proportions (see Figure 3). While proportional representation is useful for compressing large numbers, statistically bloating small numbers appears unnecessary and counterproductive.

When considering nodal data (either frequencies or proportions), individual differences are lost in the compression of data. Any design decisions based on these data are limited to conclusions about

the group as a homogeneous entity, and we sacrifice any more subtle interpretations. Furthermore, data spread across several tables, each representing a single node (or, alternatively one large table showing multiple crossbreaks), are difficult to assimilate. Patterns that exist within them are difficult to detect.

Petit-Point Pattern

This early approach to the portrayal of the audit trail was suggested by some of John Tukey's work in representing non-parametric data in what he called a 'stem and leaf' form (Hartwig & Dearing, 1979). It is a graphical approach, combining the intuitive appeal of a histogram with a character-based notational system symbolizing the choices. For example, in Figure 4, the X's represent the first choice, O's represent the second choice, and H's represent the third choice. A dot (.) is used to indicate that the learner proceeded past the node without making a choice, a situation made possible by an unfortunate bug in the program used to collect these sample data.

Although virtually any symbol could be used to represent individual choices, but we chose characters that seem to occupy the same amount of space, so that inter-character differences would not influence the overall appearance, and perhaps the interpretation, of the display. The resulting pattern of characters is in some ways reminiscent of a pattern for petit-point embroidery.

To set up a display of this kind, data must be progressively or sequentially sorted decision point by decision point. That is, subsequent columns of data in a matrix must be sorted within the categories formed by the sorted data comprising the first column.

Advantages of this method included the ease of generating the display by using a search and replace function on a word processor to substitute characters, and a line sorting feature to assist in constructing the display. Although the display accurately shows the proportions of choices made at each node in a graphic and intuitive way, the dependency problem is very evidently in play: In the fifth column, for example, there are 11 distinct groups of O's; each group has a different meaning, depending on where it is located vertically. That is, although the O's all indicate that the second of the

choices available was the one that was chosen, the first two O's and the third O represent choices on different content, due to the fact that different routes brought the learners to the node.

In one version of this kind of display, we also tried to use color to denote different choices, but found that it offered little advantage in interpretability.

This approach was eventually set aside because it didn't seem to do a great deal to describe what was happening. It was deemed to be moderately useful as a formative evaluation tool, but didn't appear to have sufficient power to make it useful for research purposes.

Audit Trail Tree

The audit trail tree (Figure 5) was the next approach we attempted. It combined both the graphical representation and the numerical accuracy of the Petit-Point Pattern approach, but, in addition, presented the data in a more intuitively powerful way.

The audit trail tree is drawn so that the thickness of the line depicts the number of learners who chose the path represented. Of course, if large numbers of learners are involved, the line width could be scaled. Too, numbers (either frequencies or proportions) could be attached to each node to provide greater detail. The visual representation appeared to be useful and somewhat easier to interpret than the Petit-Point Pattern method. It was clear, it was graphical, it was intuitive, and it was grounded in reality. Comparisons were easy to make; flow could be read into the diagram as learners progressed from the beginning to the end of instruction. Although the drawing process is not difficult to do manually, it is somewhat tedious, and automation of the process on a graphic-interface microcomputer should be reasonably straightforward.

On the other hand, unless numbers were attached (as suggested above), the precision of the display was fairly low (i.e., it is difficult sometimes to tell the difference between 3 learners and 4, or between 11 and 13). The problem of conceptual distance remained, and perhaps was magnified by the ease with which other dimensions of the data were made manifest. And, of course, the problem of how to represent the loops remained.

Inferential Approaches to the Audit Trail

Inferential approaches would be used when comparisons are being made between groups of learners (e.g., differing on cognitive styles) or treatments (e.g., using instructors of the same gender as the learners and using instructors of differing genders).

One inferential approach to the audit trail we considered and discarded involves the use of multiple regression. This traditional approach to path analysis did not appear to be appropriate for answering the types of questions we are addressing here. It is a method of analyzing linear relationships among sets of variables, and assumes that a *causal order* among the variables is known and that the relationships among the variables are *causally closed* (Duncan, 1966). Even though we didn't give this approach much consideration, we mention it because of a possible confusion of terms: We are attempting to analyze paths through instruction, in a way that bears no relationship to path analysis, as the term is used in a statistical sense.

Furthermore, in an inferential approach to analyzing choices made in hypermediated and interactive instruction, one cannot make the assumption of normal distribution that underlies parametric statistics; hence a focus on the non-parametrics is essential.

A productive approach to analyzing a class of problems such as that under discussion would be to collect data on choices made by a large group of people, and regard that distribution as the *usual distribution* (in fact, it would be an expected distribution that is 'normal' for the particular content and treatment being investigated, but since the term normal distribution has a technical connotation, we must make a distinction). Given this expected distribution, one could then subject certain individuals to treatments of varying kinds, and compare the audit trails of those subjects to the audit trails generated by the 'usual' population, on a decision by decision basis (and keeping in mind the dependency problem). That is, the comparisons could only be made for single decision nodes at a time (which could be a limitation).

A statistic such as the chi-square one-sample test, a test of goodness of fit (Siegel, 1956), would

appear to be an appropriate tool for determining the statistical significance of observed deviations from 'usuality'. Another likely candidate would be the Kolmogorov-Smirnov test (Marascuilo & McSweeney, 1977; Siegel, 1956). Indeed, since Siegel states that "the Kolmogorov-Smirnov test may in all cases be more powerful than...the chi-square test" (1956, p. 51), it would seem to be the test of choice.

Issues and Challenges

There are issues and challenges arising in both the descriptive and inferential applications of audit trail analysis.

From the point of view of descriptive applications, an important issue underlying all the audit trail methods identified above is this: How does one deal with representing the fact that an individual learner may well traverse a node more than once? On one hand it would be possible to design tracking devices which would ignore subsequent identical path choices once an individual has chosen the first time. But looping through the same path more than once may represent important data. How then can we discriminate between multiple encounters with a single individual across a path, and several single encounters with individuals? This problem remains unresolved, and deserves attention.

The highly contextual nature of all analyses continued to plague us as we searched for analytical tools. It seemed like every avenue we pursued was predicated on a thorough analysis of the treatment under study. The content not only determined to some extent which of the analytical tools were appropriate, but also limited our ability to generalize our conclusions at this stage of investigation. Certainly, we were humbled by the levels of complexity which seemed to settle like river sediment on what we initially thought was a simple notion.

The potential magnitude of an audit trail is also a challenge. Experience with collecting audit trail data in a variety of CAI and hypermedia environments (M. W. Petruk, personal communication, February 7, 1990) confirms the intuitive notion that extremely large datasets are possible. If one considers the potential number of choices available in an instructional sequence that involves any

degree of learner choice, and factors in the possibility of looping through some or all nodes, the sheer size of the audit trails becomes daunting. Given that some learners will loop more than others, the audit trail data matrix will not be square; this in itself makes it awkward to work with.

In the inferential approach involving chi-square or Kolmogorov-Smirnov, four distinct issues arise. The first has to do with the fact that any research must necessarily be conducted by comparing learner's responses at only one node at a time. If the number of nodes is large (as is liable to be the case in most instruction that incorporates learner control) then there exists the potential for an inflated a, similar to the situation where repeated t-tests are employed (Ryan, 1972). Other than recognizing the potential problem and selecting an appropriate a to compensate for it, no evident solution presents itself.

Another issue that arises in conjunction with the use of the chi-square or Kolmogorov-Smirnov test: Which expected distribution should be used? Above, it was suggested that an empirically-derived expected distribution should be employed as the "usual". However, it could also be argued that a rectangular distribution, based on the number of paths available at each node, is the distribution of choice. More development of this argument, and identification of the pros and cons of using each distribution, are needed.

If it turns out that the empirically-derived distribution is the one of choice, then this question arises: How large does the population describing that distribution have to be in order to be adequate?

Finally, there is the opposite side of the coin: What should be the size of any sample of learners used in empirical research, given the knowledge that with larger sample sizes, chi-square is known to become increasingly sensitive? That is, given a large sample size, the use of chi-square may lead to incorrect decisions to reject H0. How Kolmogorov-Smirnov behaves under these conditions is not clear.

Another consideration is that the nature of the content or subject matter may determine subsequent analyses, and we have not yet addressed this issue. In procedures we have discussed,

the data do not represent the shapes of the instruction encountered. For example, they do not describe whether the learner is engaged in concept acquisition, problem solving or chaining at any particular point. This does not always matter, but where it is an important feature for analysis, the initial content analysis will need to take this into account. It is also possible that specific analytical procedures will need to be developed to address specific instructional types.

If we are to draw a single set of conclusions from our investigation of this issue to date, we suggest that the search for a single appropriate analytical tool for interactive media research is futile. We believe a thorough analysis of audit trail data requires a combination of techniques, both descriptive and inferential, to adequately address research questions. As our experience with existing tools grows, prescriptions concerning when to use combinations of approaches may be possible, but at this point, such prescriptions would be premature. Further, rather than viewing the context-dependence of each analysis as a barrier or limitation, we believe it is more productive to view content or task analysis as a prerequisite step to any further analysis.

Subject	1	2	2	2	2	1	1	1	1
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Subject	3	2	2	2	2	1	1	2	1
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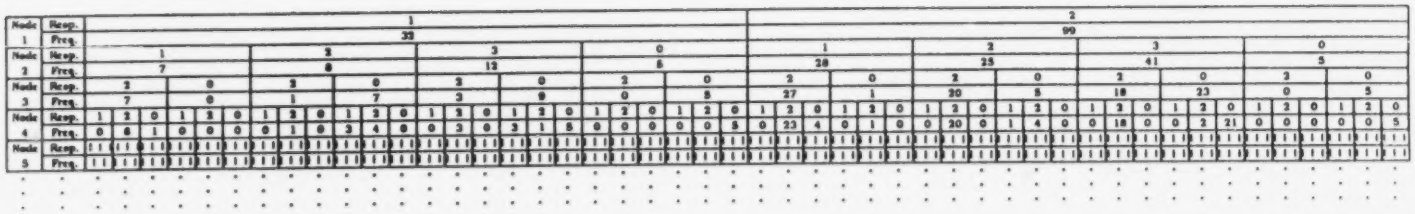
Subject	126	1	1	2	4	4			
Subject	127	2	1	2	2	4			
Subject	128	2	1	2	2	4			
Subject	129	2	1	2	4	4			
Subject	130	2	1	2	4	4			
Subject	131	2	1	2	4				

Figure 1. Sample raw data matrix.



Node	Resp.	1																2											
1	Freq.	33																99											
Node	Resp.	1			2			3			0			1			2			3			0		
2	Freq.	7			8			13			5			28			25			41			5		
Node	Resp.	2	0		2	0		2	0		2	0		2	0		2	0		2	0		2	0	
3	Freq.	7	0		1	7		5	8		0	5		27	1		20	5		18	23		0	5	
Node	Resp.	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0	1	2	0
4	Freq.	0	6	1	0	0	0	0	1	0	3	4	0	0	3	0	3	1	5	0	0	0	0	0	5	0	23	4	0	1	0	0	20	0	1	4	0	0	18	0	0	2	21	0	0	0	0	0	5
Node	Resp.																																														
5	Freq.																																														

Figure 2. Tabular representation of raw frequencies of paths chosen in sample data. Although the sample data actually have eight decision nodes, only four are presented here, for simplicity. Note how quickly the size and complexity of the table grows as the number of decision nodes and/or the number of choices available at each node increases.

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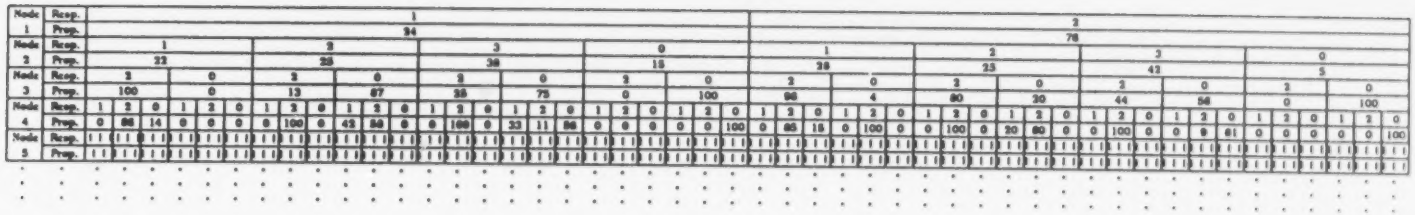

Figure 3. Tabular representation of proportions of paths chosen in sample data for first four decision nodes. Note how, as one progresses through more decision nodes, smaller frequencies of responses produce deceptively larger proportions.

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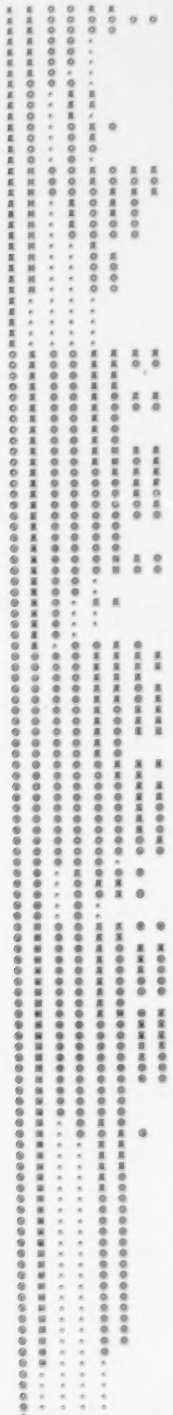

Figure 4. Petit-Point Pattern method of representing an audit trail. An X represents the choice of the first possible path from a node, an O represents the second, and an H represents the third. A • indicates no response.

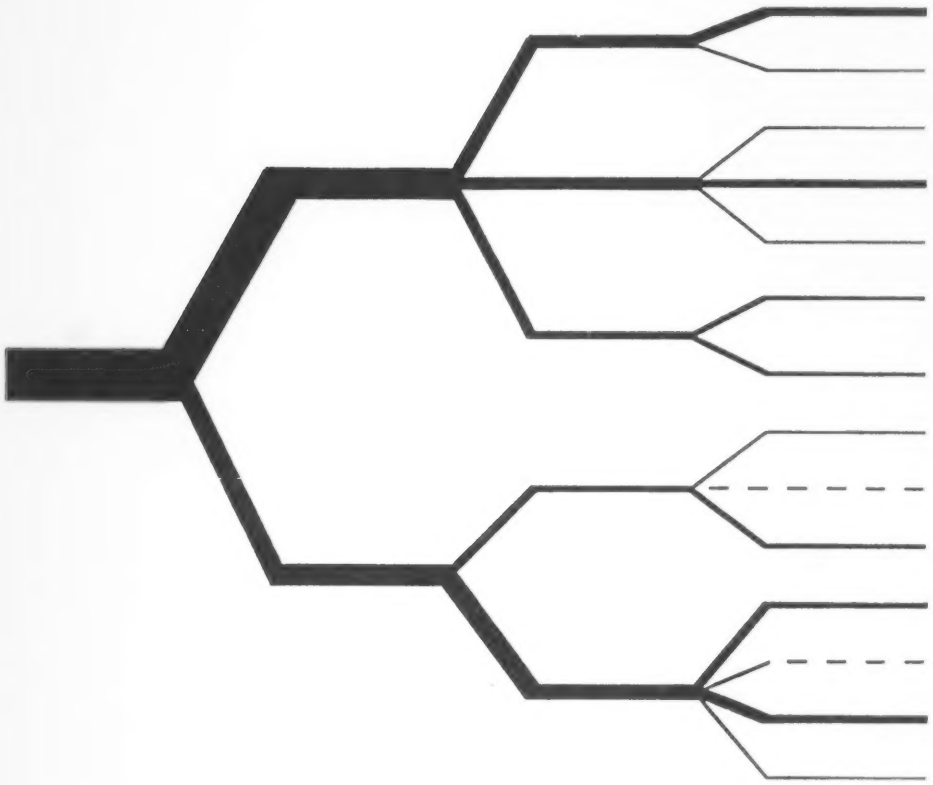

Figure 5. Audit Trail Tree of example data. The width of the line represents the number of learners taking any given path. A dashed line indicates no learners took the path.

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SUMMARY

While scholars and pundits may debate the state of the world of educational technology, and seers may claim to see its future, most of us are too busy working at educational technology to stop and ponder the larger questions. But if we are to have a future as educational technologists we all have to take responsibility for pondering and debating the ideas, the concepts, the theories, and the philosophy of our field.

The future is now. Let's get on with it!

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